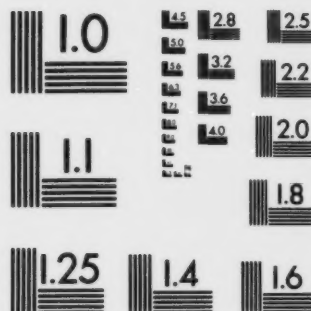


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**Transportation and Telecommunications:
An Examination of Substitution
and Stimulation**

TRANSPORTATION AND TELECOMMUNICATIONS:
AN EXAMINATION OF SUBSTITUTION AND STIMULATION

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SUMMARY

The purpose of this study is to investigate recent developments in those factors that influence the interaction between intercity transportation demand and telecommunication systems and to assess the extent of such interactions, namely the level of substitution of telecommunications for travel and stimulation of travel attributable to telecommunications. Also, a knowledge of the impacts (e.g., energy) of substitution and stimulation is of interest due to their importance to Canadian transportation and other public policy objectives.

This research is intended to overcome notable information gaps in the determinants of substitution and stimulation phenomena by a systematic study of factors and interrelationships in and between: communication needs, technical capability and cost of telecommunications, human factors including attitudes, and transportation-telecommunications tradeoffs in different representative spatial and service contexts. While the complexities and uncertainties inherent in the subject are appropriately recognized, it is nevertheless expected that a better understanding of the determinants and their interrelationships will provide an improved basis for projecting the effects of rapidly evolving telecommunications on transportation demand and related factors.

There is considerable current interest in the subject of the interaction of transportation and telecommunications. Air transportation industry members have accorded much importance to the subject by expressing their concern that teleconferencing, more than any other single factor, will affect the growth of the most lucrative segments of their market -- business travel. Telecommunications firms, agencies and institutions would like to gain an insight into the extent of substitution with the objective of learning about the market potential for teleconferencing. Government agencies have a number of interests in the subject of this research. These include energy savings, and effects on transportation carriers, services and facilities. The interest of the Canadian Transport Commission in the subject, which dates back to the seventies, relates to its statutory obligations as the regulator of the air and rail transportation in Canada.

The research framework developed in the conduct of this study consists of: information acquisition from Canadian and international sources, formulation of hypotheses, investigation of communication needs, an assessment of technical and cost characteristics of telecommunications, an analysis of trends leading to the increased use of teleconferencing including attitudes towards the telecommunications media, a study of travel-telecommunications trade-offs and the assessment of the degree as well as the phased evolution of the substitution and stimulation effects. The approach followed in the implementation of the framework attempts to provide a clear insight into the complex phenomena under study, delineates the essence of problems, and identifies linkages (correlations) between the important variables on the basis of available data and judgement.

Major factors that affect the interaction of transportation and telecommunications are identified to be: communication needs and tasks, quality and cost of telecommunication modes, regulatory policies, institutional factors, support structure, market pull, economic conditions, life style including values and attitudes, quality and cost of transportation, urban and regional development factors, energy supply problems, travel contexts, incentives for the use of teleconferencing and perceived user benefits. The influence of these factors is researched under the components of the research framework noted above.

A fundamental component of this research is that of the identification of communication needs that normally require travel but could be satisfied effectively through telecommunications. Furthermore, the identification of communications that evolve from the use of telecommunications and result in travel is of much importance to this study. A number of studies in Canada and elsewhere have produced remarkably similar results in terms of the nature of meetings and the percentage of meetings that could be carried out through teleconferencing. On the basis of these findings, about 40% to 60% of all business meetings involving transmission of information, information exchange and similar tasks are potentially substitutable by teleconferencing.

Recent research suggests that tasks involving negotiations (with risk) could even be regarded as substitutable. This, of course, implies that 60% or even a higher percentage of business meetings can potentially be carried out by teleconferencing. A number of non-business communication needs are potentially substitutable. Examples include: social services, education, medical information exchange and training, voting, and shopping (for specific needs).

In addition to the telecommunications-induced travel stimulation for non-business tasks (e.g., personal social visits), business travel could be stimulated as well by telecommunications. For example, implementation-oriented tasks and negotiations involving travel could evolve from a teleconference.

The interaction of intercity transportation and teleconferencing is likely to increase as a result of improved teleconference systems and services. The effectiveness of the telecommunications media is likely to increase substantially with respect to availability, the conduct of communications tasks, cost and "user friendly" attributes including convenience. The influence of pro-competitive policies as well as technology developments is likely to render teleconferencing affordable for a large segment of the business community.

Due to the confluence of the technologies of computer and communications, a large number of telecommunication services have come into commercial service on a network (domestic and international) basis. Teleconference services available in Canada today range from simple audio facilities through narrowband slow scan (freeze frame) video systems to full motion two-way colour video augmented with stereo audio and conference support facilities. Significant developments in terms of service demonstrations and commercial services are also taking place in the U.S.A., Europe, and Japan. International teleconferencing has become technically feasible due to specially designed picture processing and signal compression equipment (i.e., Codec) that overcomes the difficulties of different videoconference equipment standards in North America and Europe.

Developments in videoconference systems are, however, recent in nature since until recently the technology to reduce transmission capacity and cost was still in the testing stage. It was only as late as 1983 that satellite-based videoconference systems for domestic, transborder and international communications were introduced in commercial services. Such services, namely Telecom Canada's Conference 600 (for domestic and trans-border use), Teleglobe Canada's Confratel (for international services), existing demonstrations, permanently installed private and public facilities, developments in technology with cost-reducing effects, and innovations in office automation as well as related technologies are examined in this research in terms of their impact on intercity transportation demand.

There is an increasing trend toward teleconferencing in business, government services, education and medical services. In addition to technological developments (with significant cost, quality and capacity effects), human and institutional factors are becoming favourable. This report covers trends leading to increased use of teleconferencing. Results of recent surveys in Canada and the U.S.A. are discussed which suggest that a substantially high percentage of businesses (almost three-quarters in Ontario) are already using teleconferencing and that respondents have experienced travel reduction as well as stimulation owing to the use of teleconferencing.

Recent economic recession, it appears, has resulted in an interest in teleconferencing for business communications and that such interest is positively correlated with the size of a company's travel budget, and the extent of intra-organization communication needs of multi-branch national and multi-national corporations. At present, the interrelationship between travel budget and teleconference/telecommunications costs is hardly formal but survey results indicate that in the future, organizations which need to reduce their travel activity would seriously consider teleconference as a viable option.

The strengths and weaknesses of each teleconference mode are studied. The cost of developing private studios and tariffs of public teleconference facilities are assessed in association with the user requirements for service features. Inferences are drawn about the potential of each type of teleconference system (i.e. audio, audio-graphics, freeze frame and video-conference system) to serve as an effective substitute for face-to-face in-person meetings. The attraction of videoconferencing (owing to its simulation of in-person meetings) is noted. On the negative side, its currently high price is indicated as a constraint to its wide spread adoption for business communications. Teleconference market size and a profile of its penetration in the office (business) market are projected in this research.

Intercity transportation and teleconferencing trade-offs are examined for representative travel contexts. These include: short haul, long haul, and North-South travel (in Canada). Quantitative estimates of the present and projected differences in cost and service are developed for short haul (i.e., Toronto-Montreal), long haul domestic (i.e., Toronto-Calgary) and Toronto-London, England). The effects of distance and relative cost reductions in teleconferencing (that are likely to materialize over time) on the extent of generalized cost savings are assessed. Results in brief, suggest that at present videoconferencing is in general costlier than travel whenever a small travel party size is involved. However, due to cost decreases in teleconferencing in relation to costs associated with transportation, projected in this research, the electronic media is likely to become increasingly more attractive in the future.

Analyses of the relative attraction of teleconferencing in a number of travel contexts are reported. Results indicate that while the cost savings owing to replaced travel are relatively more favourable for long haul domestic and international routes, the inconvenience of short haul (same day return, routine) travel involving same destination renders such locations equally attractive for travel substitution. In the case of North-South travel within Canada, the high cost of air travel combined with the inconveniences of limited flight schedules and necessary layovers make such links also attractive

for the substitution of travel with teleconferencing. The low prospects of the availability of commercial services owing to low density of communications suggests a role for institutional/governmental installation of freeze-frame or full motion (compressed) videoconference systems for North-South communications.

Estimates of replaced business air and rail (short haul) trips are developed for future years. It is projected that starting from almost negligible level of replaced travel in 1984/85, in year 2000, 10% of business trips normally made by these modes are likely to be replaced by teleconference systems. The 10% replacement level is the balance of estimated 11% substitution and 1% stimulation levels. With reference to the case of travel growth profile which is not affected by teleconferencing, estimates of replaced travel and energy savings are developed. Other impacts such as those on transportation facilities and the effects on documents traffic are also discussed.

Recommendations arising from the results achieved in this investigation are presented. These include recommendations on monitoring the developments in travel substitution and stimulation, improving the information base through the addition of questions on travel survey questionnaires, further work on the quantification of cost and service differentials involving surveys of users of commercial videoconference services, enhancing the knowledge of the role of teleconference as well as availability (for use by government personnel) through federal and provincial government initiatives.

CHAPTER 1

INTRODUCTION

1.1 Background

Historically, telecommunication* systems have served the transportation sector in an essential complementary role. Telephone and telegraph services, for example, have performed key supporting functions in railway transportation. The complementarity of telecommunications and transportation continues to grow in scope. The association of transportation and telecommunications has also been very visible in Canada, in one instance in the form of a joint ownership of these enterprises -- namely CN-CP telecommunications. Furthermore, during the early years of the establishment of the Canadian Transport Commission (CTC), telephone and telecommunications services fell under its regulatory jurisdiction. Telecommunications also relate to transportation in the form of actual or potential effects on transportation demand. This interrelationship is treated in the research study reported here.

The impact of telecommunications on transportation demand in the form of substitution of telecommunications for travel and/or the stimulation of travel has been a topic of research interest for more than a decade. In response to the information precipitated by the impressive advances in micro-electronics, computer and communications technologies, major strategic transportation studies in the seventies and early eighties have quite appropriately raised the relevant questions. However, the treatment of the subject has not been comprehensive [2,3].

* Telecommunications means any transmission, emission or reception of signs, signals, writing, images, sound or intelligence of any nature by wire, radio, visual or other electromagnetic system [Reference 1]. Also, please see Appendix A for glossary of technical terms.

In the seventies, a number of research groups were established by telecommunications firms as well as government agencies for the investigation of the effectiveness and acceptability of telecommunications media for business meetings [4,5,6]. The results of such investigations, although useful in gaining an insight into the subject through laboratory and attitude research efforts, were largely inconclusive. Cautionary statements were made by investigators in the seventies that there were no simple answers to the questions of travel substitution* and stimulation.*

Still, in the eighties, the questions of substitution and stimulation continue to be posed. An added dimension to these research issues in the eighties is the degree of realism caused by further technological developments in computer-communication systems, increased availability of teleconferencing** and data communication systems, and a growing number of teleconferencing installations [7,8].

In recent years, technological developments in computer-communication systems in terms of enhanced technical capability and capacity, and reduced cost and size, have caused these systems to become generally affordable and convenient while offering acceptable quality of message. Coupled with such technical developments is the growing importance of information occupations and information-related activities in Canada. On the other hand, transportation and accommodation costs, mainly for business travel, have been perceived to be rising given service quality. These developments in conjunction with the energy conservation objective have, in theory, enhanced the attraction of teleconferencing as a viable alternative to travel [9,10]. In spite of these developments and a renewed interest in the subject, there are significant gaps in the area of travel substitution and stimulation [11,12].

* In this report the term "substitution" is used for the substitution of telecommunications for transportation. Also, the term "stimulation" is used for the generation of new travel owing to the use of telecommunications.

** Teleconferencing means two way interactive communications between three or more persons in two or more locations by means of a telecommunications medium [1].

Motivations for an interest in the topic of this research differ from one interest group to the next. Telecommunications firms, agencies and institutions would like to gain an insight into the extent of substitution in order to estimate the market potential for such services [13,14]. It has been suggested by telecommunications service suppliers that they are not necessarily interested in diverting travellers from transportation modes since they view teleconferencing as an enhanced communications service with potential to generate a new market and replace other communication modes.

In the transportation sector, especially air transportation, there has been much speculation and concern related to loss of traffic to teleconferencing. Estimates reported suggest a reasonably high level of diversion -- 10% to 30% of business travel [15,16,17]. Travel industry members expressed their concern that "teleconferencing, more than any other single factor will affect new plane orders and airline profitability for the rest of the century" [17]. Government agencies such as the Ontario Ministries of Transportation and Communications, and of Energy, and the U.S. Department of Energy have been interested in assessing the extent of energy conservation achievable through the substitution of telecommunications for travel [9,10]. It is logical to see an interest on the part of the Canadian Transport Commission (CTC) and Transport Canada since impacts on transportation carriers and related socio-economic issues could arise.

Previous research sponsored by the CTC in 1974, carried out by the author, has been frequently cited by other researchers in Canada and abroad [1]. More recently, in Canada, the Ontario Ministry of Transportation and Communications and Transport Canada have also been active in this general area [11,12]. Likewise, research on this subject has been carried out in other countries. Owing to the rapidly changing nature of technological and policy factors, and the substantial uncertainties involved, further research is required to go beyond the findings of other studies on this subject.

This investigation was initiated to overcome information gaps owing to an inadequate understanding of:

- the factors that favour substitution and stimulation of travel,
- substitutable communication needs,
- communication needs that could potentially be stimulated,
- trends in cost, technical capability and capacity of computer-communication systems,
- transportation-telecommunications trade-offs in different spatial and service contexts (e.g., short haul corridors, long haul air links),
- user attitudes,
- substitution and stimulation impacts on air and other carriers, and private automobile transportation, and
- energy and other impacts of substitution and stimulation.

The research reported here was designed to provide information on the above named topics by examining substitution, stimulation and their impacts. This study was intended to go beyond other studies on the subject. As for its relevance to federal institutions, considering potential impacts on air carriers and passenger rail, this research directly relates to statutory obligations of the Canadian Transport Commission.

1.2 Purpose and Scope

The purpose of this study was to identify the latest developments in those factors that affect interaction between transportation and telecommunications and to assess such interactions, namely substitution and stimulation, as well as their impacts.

Specifically, this research was intended:

- (1) To review the information and major findings (i.e., data, analyses, conclusions and recommended research extensions) of previous studies on the subject, and assess their relevance.
- (2) To acquire (from available sources), analyze and project information on trends in transportation and telecommunications traffic, user attitudes, technology and costs.
- (3) To suggest possible and probable future patterns and locations for the substitution of telecommunications for travel and stimulation of travel, and

- (4) To assess the impacts of substitution and stimulation phenomena on the relevant impact groups including transportation carriers.

It was intended that this investigation should go beyond other studies on the subject in terms of providing information on factors which at present are inadequately understood. Considering the extensive nature of the subject and the attendant uncertainties, a broad coverage of the subject was the logical choice. Consequently, this research attempts to cover relevant aspects of technological, economic and human factors related to both transportation and telecommunications under severe data constraints. However, the treatment of a number of facets of this subject in terms of level of detail is inevitably compromised.

A second area of research scope limitation is that of its focus on inter-city travel. That is, the contexts for the examination of substitution and stimulation include intercity domestic, Canada-U.S.A., and international services. Although the influence of the urban-based developments (e.g., office automation) are covered, the treatment of telework within the urban setting is beyond the scope of this research.

A third limitation of this research is that it focusses mainly on the substitution and stimulation phenomenon related to passenger travel. While a preliminary treatment of the impacts of telecommunications on the transportation of documents is presented here, a detailed assessment of the impacts is beyond the scope of this study.

1.3 Study Approach and Report Organization

In support of the overall purpose and specific objectives of this investigation, eleven work plan items (i.e., tasks) were defined, the last item being the preparation of this report.

The method of approach followed in this investigation was developed to suit the special requirements of this research study. In addition to developing the research framework, a considerable part of the initial time input was devoted to defining information needs, acquiring selected information, reading and analyzing subjects that are background in nature or directly related to topics covered in this research.

As an overall perspective of the method of approach, it was not intended in this research to impart basic principles on technology, system design, economics, social or psychological factors. Rather the approach that had been followed was to reduce complex phenomena to intelligible terms, to extract the essence of problems and to present linkages (correlations) between variables based on data and judgement.

A second factor influencing the method of approach was the treatment of the elements of the framework within which transportation and telecommunications interrelationships can potentially occur. Thirdly, considerable emphasis was placed on the study of structural relationships and anticipated changes in these relationships owing to a large number of factors within which computer-communication systems serve as catalysts.

The study approach called for information acquisition through literature search, contacting a large number of persons and agencies for information and selected interviews on specialized topics. Literature was searched through bibliographic retrieval services, a manual check on journal articles, conference papers, books and reports. Over two hundred literature items were identified and reviewed.

Additionally, a large number of agencies and institutions were contacted throughout the world in order to develop a complete picture of research in the area of this study. In most instances the response was positive and meaningful. The methods used to obtain the information involved personal visits, telephone interviews and correspondence. In the absence of a direct response from a limited number of individuals or organizations, their recent conference papers

published in journals were used as a basis of information. The acknowledgements sections of this report lists information sources.

The research framework which was developed at the outset of this study is reported in Chapter 2. The major features of this framework including teleconferencing concepts, communication needs, interaction of transportation and teleconferencing, and the influence of major factors are covered. Chapters 3 to 7 report detailed treatment of the factors included in the research framework.

Chapter 3 elaborates on teleconferencing systems and the environment (e.g., regulatory policies) under which such systems and services are operated. Chapter 4 reports on technological developments in telecommunications in terms of performance, capacity and economic factors. Chapter 5 examines trends leading to increased use of teleconferencing. Included in Chapter 5 are the analyses of information obtained from case studies, user attitude surveys as well as rates and service characteristics of existing systems.

Trade-offs between transportation and telecommunications are examined in Chapter 6 in service and cost terms on an area-specific basis. That is, these trade-offs are discussed for short haul corridor routes, long haul routes, transborder and international routes, and North-South travel in Canada.

Chapter 7 reports the nature and level of travel impacts. Also, selected impacts of substitution and stimulation, namely energy and infrastructure impacts are noted. Finally, Chapter 8 covers major conclusions and recommendations arising from this investigation. Following a list of references cited in this report, three appendices are included. Appendix A provides definitions of technical terms used in the report. Appendix B summarizes user attitudes as reported by selected important surveys. Appendix C provides a bibliography of selected recent literature.

CHAPTER 2

HYPOTHESES AND RESEARCH FRAMEWORK

2.1 Basic Elements and Interrelationships

In the development of the research framework, it was considered desirable to view the topic of the interaction of transportation and telecommunications from a broad perspective. A narrow treatment of the topic, it was feared, would render this study to be of limited value. Consequently, it was decided that all relevant major factors should be included in the overall research framework and that their interrelationships should be investigated.

Basic elements and their interrelationships shown in Figure 2.1 comprise the research framework. As previously noted in Chapter 1 of this report, information acquisition was carried out through literature review, visits to carriers, selected users of services and interviews, correspondence, and data gathering from a number of sources. A list of major factors and their influence on the substitution and stimulation phenomena is presented in Section 2.1.1. A description of the remaining elements of the research framework is provided in Section 2.1.2 under the title of Research Plan Implementation.

2.1.1 Influence of Major Factors: Some Hypotheses

Table 2.1 lists major factors and those sections of this report where the effect of these factors is analyzed. The intent of defining the influence of these factors here as a part of the research framework was to suggest the nature (i.e., direction) and importance of the effects rather than their magnitude.

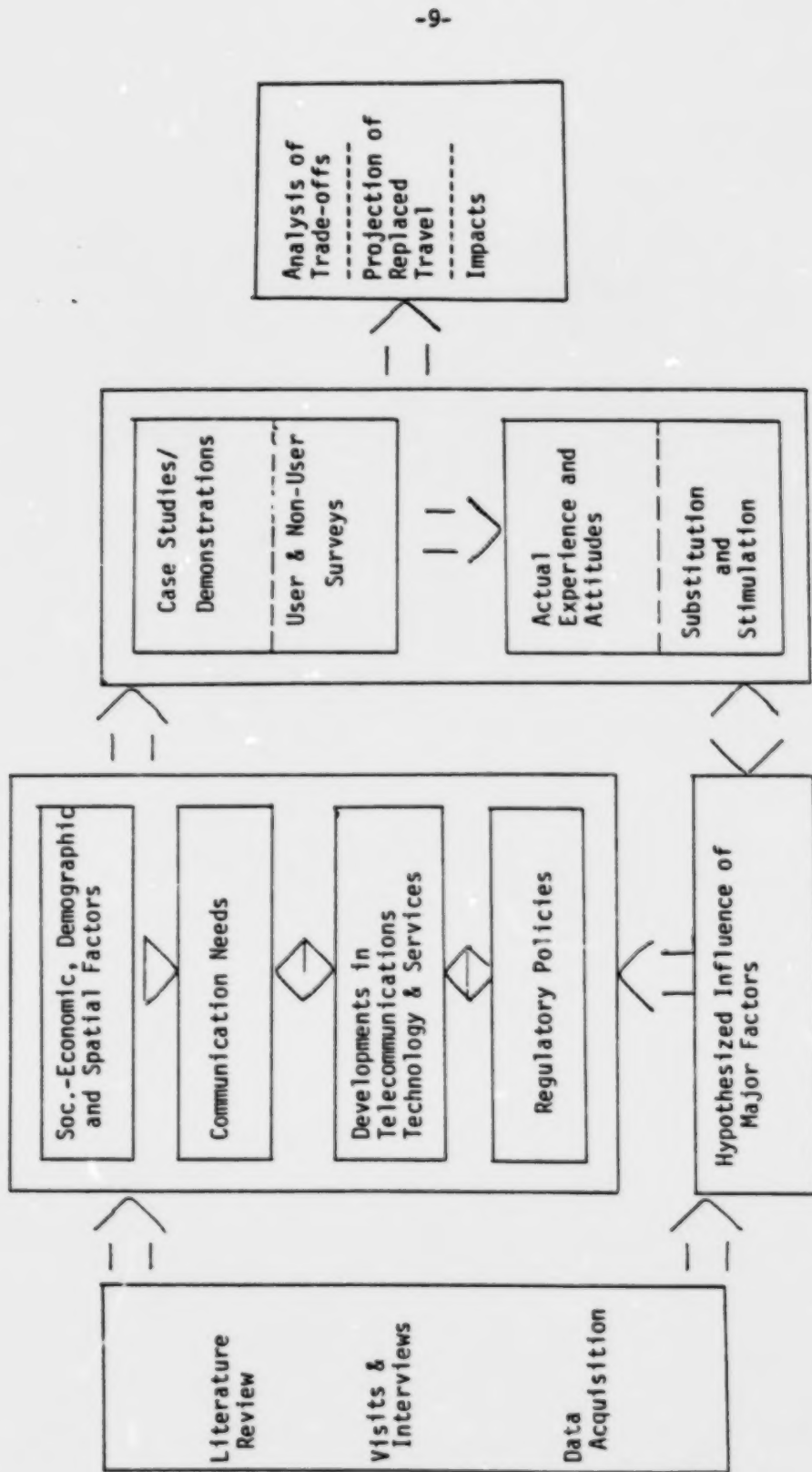


Figure 2.1: Research Framework

Table 2.1

Major Factors That Affect The Interaction
of Transportation and Telecommunications

<u>Major Factor</u>	<u>Report Section(s)</u>
• Quality and cost of telecommunications	2.2, 3.1, 3.2, 3.4, 3.5, 4.2,, 4.3
• Communication needs	2.3, 6.1, 6.2, 6.3, 7.1
• Regulatory policies	3.6, 6.3, 7.1
• Institutional factors	3.5, 3.6
• Support structure	3.1, 3.2, 3.4
• Market pull	2.2, 2.3, 2.4, 3.1, 3.4
• Economic conditions	5.1, 5.2, 5.3
• Life style, values and attitudes	5.1, 5.2, 5.3
• Quality and cost of transportation	6.1, 6.2, 6.3, 7.1, 7.2, 7.3
• Urban/regional development patterns	2.4, 3.2, 3.3
• Energy supply problems	6.2, 6.3, 7.1
• Travel contexts	3.1, 5.1, 5.2, 5.3, 6.1, 6.2, 6.3
• Incentives for the use of teleconferencing	5.2, 6.1, 6.2, 7.1
• Perceived benefits	6.2, 6.3, 7.1

(a) Quality and cost of telecommunications: Increased availability, improved quality, reduced cost and increased convenience of telecommunications services are expected to enhance travel substitution potential. Stimulation of travel, although to a lesser extent than substitution, is also likely. Up to now, a number of constraints have been involved (e.g., the high cost of video conferencing). Further developments in technology will make widespread use of teleconferencing practical. In association with technical developments, there is considerable "technology push" at present.

(b) Communication needs: Most research studies suggest that teleconferencing could be used for about 40 to 60% of all business meetings. The level of substitution is of course the unknown variable. Also, the extent of business travel stimulation is unknown. While a number of non-business communication needs could be regarded as substitutable (e.g., social services, education, medical information exchange, etc.), research questions arise in the case of travel for social and recreational reasons in respect of their substitution or stimulation.

(c) Regulatory policies: These have an influence on the development and use of teleconferencing services (e.g., terminal attachment and interconnect decisions in Canada and the U.S.A.). Competitive environment (resulting from deregulation or regulated competition policies) could result in diversified, improved service at reduced cost. Future policy developments in respect of rates (long haul toll vs. local), satellite rates and capacity allocations, further interconnect activities, and relaxed market entry and other pro-competitive policies are likely to enhance teleconferencing activities.

(d) Institutional factors: A number of institutional factors are contributing to the growth of teleconferencing. These include: (i) relaxation of the restrictions on transborder transmission, (ii) sharing of satellite capacities between Canada and the U.S.A., (iii) operating agreements (transborder, international) have become possible, and (iv) PTT's (Post, Telephone and Telegraph agencies) in Europe are cooperating with Teleglobe Canada and U.S. carriers. However, a number of institutional constraints still remain.

(e) Support structure: Integrated sets of activities commonly called support structures are required in order to promote successful applications and the integration of teleconferencing into an organization. Examples include: training, promotional activities, and software development. These activities were virtually non-existent until recently.

(f) Market pull: Surveys of organizations show that a market is developing for teleconferencing. Moreover, U.S. companies appear to be interested in promoting products in Northern markets. Through U.S.-based ad hoc teleconferencing, Canadian sales persons could be reached at low cost.

(g) Economic conditions: General economic conditions affect travel and telecommunications expenditures made by organizations and influence the availability of investment capital for the development of in-house studios. Recent interest in all forms of teleconferencing has been in part a function of the recent recession which has forced businesses to look into means to reduce costs and improve productivity.

(h) Life style, values and attitudes: Human factors play an important role in influencing the acceptance of teleconferencing as a substitute for person-to-person meetings and the stimulation of travel. These are to be studied in this research in association with other important factors identified here. Logically, increased attention to human factors while implementing teleconferencing, particularly to promotion and software, is essential for the acceptance of teleconferencing. Current developments in office automation (noted in Sections 2.2 and 4.2) may contribute to the enhanced awareness and acceptance of technological change.

(i) Quality and cost of transportation: Increased availability, improved quality, lower cost and increased convenience of transportation services reduce the incentive to substitute teleconferencing for travel and may even enhance stimulation potential. Available information indicates that transportation attributes as perceived by users are not expected to change dramatically under stable energy supply conditions. The implementation of high speed

passenger train service or MAGLEV would change user perception of transportation. Under the current stable energy situation and policy reforms in respect of air transportation, future costs of transportation may grow at a rate that is not higher than general inflation.

(j) Urban/regional development patterns: Telecommunications and regional structure are mutually reinforcing. Improved telecommunications could lessen the business locational constraints. Improved telecommunications facilities could serve as a complement to business travel -- with both substitution and stimulation type of effects. On the other hand, clustering of businesses and their proximity to common teleconferencing studios in centralized or satellite-corridor type of urban developments may enhance the substitution potential.

(k) Energy supply problems: Teleconferencing as a substitute for travel would find enhanced acceptance under conditions of energy supply difficulties. Under such conditions, fuel rationing as well as price escalation are likely to result. Both would curtail travel and increase the prospects of teleconferencing.

(l) Travel contexts: Substitution/stimulation of travel may be non-uniform in short haul corridors, long haul (domestic, transborder, international) routes, and Canadian North-South travel contexts. That is, travel context may have an influence on the extent of substitution/stimulation. One reason is that cost-differentials between transportation and teleconferencing are different. As noted, in this report, satellite transmission enables teleconferencing costs to be distance-insensitive.

In theory, relative cost and time considerations suggest that long haul and north-south travel should be substitutable to a higher degree than short haul travel. There are however, other considerations. Short haul corridors requiring same day return or overnight stay are attractive locations for travel substitution owing to the inconvenience of travel and relatively low incentive to travel for frequent trips to the same destination. Long haul air links (domestic/international) require longer travel times for a relatively short time spent in meetings -- thus favouring substitution. On the other hand, international travel has associated attractions -- especially for the infrequent traveller.

Clearly, without research, a definite answer cannot be given.

(m) Incentives for the use of teleconferencing: Governments may decide to offer incentives for the use of teleconferencing in the public sector and promote its use in the private sector. As an extreme case, government-mandated use of teleconferencing could be implemented. Government of Ontario, for instance, uses teleconferencing in support of its functions and promotes its use through its Transportation Energy Management Program (TEMP). Incentives for the use of teleconferencing could be offered in the private sector as well.

(n) Perceived benefits: The benefits of teleconferencing are becoming known. In theory, the list of benefits is a long one indeed and includes quantifiable (e.g., time and cost savings, increased productivity) as well as non-quantifiable (i.e., intangibles such as improved communications, enhanced image of a company as business leader) benefits. There are of course disbenefits as well. A study of benefits/disbenefits in terms of their nature and relative importance as perceived by consumers is essential to an analysis of travel-telecommunications trade-offs.

2.1.2 Research Plan Implementation

From a knowledge of socio-economic, demographic, spatial factors as well as surveys of users of telecommunications and transportation systems, communication needs were identified. Also, on the basis of available information, substitutability of telecommunications for travel was hypothesized for specific communication needs. On the technology side, current status of computer-communication systems and services was reviewed and the likely future developments in such systems were investigated. A study of existing and emerging regulatory policies and institutional factors was carried out and their likely influence on the service and cost structure of teleconferencing was examined.

The next set of research tasks included an examination of teleconferencing case studies/demonstrations, and user and non-user surveys. The purpose of this examination was to note actual substitution and stimulation experiences as reported by users, as well as to investigate attitudes of users and non-users.

Following an examination of user-related, technical and service context factors and their interrelationships, the next logical steps were to study transportation-teleconferencing trade-offs and to assess the type and extent of travel and other (e.g., energy) impacts.

2.2 The Teleconferencing and Data Communications Concepts

Before discussing the communication needs and the likely telecommunications substitutes for in-person meetings or other activities involving transportation, it is important to first introduce telecommunications concepts. Teleconferencing allows a group of users to interact through a communications medium. This interaction could take place in real time on a point-to-point, point-to-many points and between many points basis. The earliest example of teleconferencing is probably the telephone conference call. During the 1970s, this approach has been extended to include both video teleconferencing and keyboard (i.e., computer) conferencing. The former attempts to approximate face-to-face interaction, while the latter is largely confined to written material and eliminates the need for real time interaction.

Owing to the confluence of the technologies of computer and communications, the past fifteen years have witnessed the development of a large number of telecommunications services (on a network basis) for voice and/or data traffic in Canada and elsewhere in the world. Also, there is the beginning of the offer of commercial teleconference services including video conference for domestic, transborder and international communications.

A large number of services for teleconferencing, voice and/or data communications offered in Canada for domestic and international use are described in Chapter 3. Their configurations and capabilities vary from service to service. Each service type (e.g., direct distance dialling, Telex, TWX, conference services) is designed to fill a special need of the market. Teleconferencing concepts (namely audio, graphic and video) can be classified on the basis of the type of exchange, the message base or medium (audio, words, visual), and the

degree of realism of the video message (i.e., standard broadcast quality or full motion, freeze-frame or slow-scan) and the associated communication channel capacity (i.e., bandwidth) requirements. Chapters 3 and 4 provide a detailed description of technological factors.

Developments in teleconferencing and data communication concepts in some respects relate closely to the emergence of the "automated office" concept and its associated services such as local area networks (LAN), electronic mail and videotex. A local area network generally means a digital communications facility designed to carry data at high speed among a large number of information processors directly interconnected within a building complex. A large number of local area networks could be involved in the case of geographically distributed corporations and might be connected over a commercially available network, probably involving a private automatic branch exchange.

The concept of electronic mail in an office setting is a special form of computer teleconferencing. This concept could be applied to the delivery of messages as a direct substitute for letter mail. The services known as Teletex (allowing little or no viewer interaction) and videotex (allowing user manipulation of the database) use television technology in providing instant access to remote databases, including pictorial material. The prospects of commercial opportunities for videotex in particular have resulted in major technical developments including the Canadian Telidon system.

2.3 Communication Needs

A fundamental item of research on the interaction of transportation and telecommunications is that of the identification of communication needs that could be satisfied effectively through telecommunications. Research on this topic has been carried out in many countries and the results were reasonably consistent. In the pursuit of such research, it was recognized that:

- (1) both transportation and telecommunications, by enabling human interaction, contribute directly or indirectly to the satisfaction of human communication needs,
- (2) from a knowledge of travel generating communication needs (as shown in Table 2.2), the relative attributes of travel and telecommunications modes, and other relevant factors (as noted in Section 2.1.1), the substitution as well as stimulation variables could be scientifically studied, and
- (3) a delineation of substitutable communication needs depends upon many factors, including the nature of tasks to be performed, communicators' behavioural attitudes and preferences towards the medium, which is partly influenced by the attributes (e.g., quality) of the medium.

Some person-to-object types of interactions can take place without travel. Examples include remote visual inspections, remote monitoring of instruments, remote manipulation of objects or tools, or a combination of the above. Person-to-person interactions, on the other hand, could involve both substitutable and non-substitutable communication needs. A determining factor, although by no means a very reliable one, is the purpose of communication (e.g., business, social, etc.).

Since 1970, laboratory experiments and actual demonstrations have been carried out in the U.K., Canada, U.S.A., Australia, Japan and Europe for the investigation of the effectiveness of audio, audio plus graphics and video conferencing relative to in person meetings. Also, in these countries, survey data have been used to derive estimates of the frequencies with which different types of meetings occur. Most researchers have combined these estimates with the results of the laboratory experiments as well as a number of bold assumptions in order to provide estimates of the extent to which audio and video conferencing would be regarded as effective substitutes for business and other meetings.

On the basis of a large number of research reports and papers, substitutable communication needs were identified. These are shown in Table 2.3 in association with logical telecommunications substitutes.

Table 2.2

Travel Generating Communication Needs

Person-to-object interaction	• Visual contact only; inspection • Visual and physical; message orientation, use of fixed equipment, use of tools and instruments, acquiring goods, and acquiring information
Person-to-person interactions	• Business/work, personal business, social - face-to-face • one-to-one; business/work, personal business, social • one-to-many; business/work, social • several-to-several; business/work, social - written or printed • one-to-one; business/work - audiovisual • one-to-many; business/work

Table 2.3

"Substitutable" Communication Needs
(Based on Research Carried Out in the 1970s and Early 1980s)

Communication Need	Substitutable?		Telecommunication Substitute
	Yes	No	
• <u>Information exchange (routine)</u>	x		Teleconferencing
Sales meetings			
Staff training			
New product or service introductions			
Project control and status reporting			
Committee meetings			
• <u>Information exchange (recent events)</u>	x		Teleconferencing
Problem solving			
Remote consulting			
Scientific and technical information exchange			
Seminar			
• <u>Information transmission/exchange</u>	x		Electronic messaging mail
Messages/mail			
Ordering items (shopping for business)			Teleshopping
Funds transfer			Electronic funds transfer
Forms processing			Teletex
Transmission of text/word processing			Teletex
Joint authorship			Teletex
Transmission of data			Data communications

Table 2.3 (continued)

"Substitutable" Communication Needs

(Based On Research Carried Out in the 1970s and Early 1980s)

Communication Need	Substitutable?		Telecommunication Substitute
	Yes	No	
• <u>Exploratory Communications</u> Identification, review of considerations basic to establishing a policy or plan of action	x		Teleconferencing
• <u>Transactional communications</u> * Airing conflicting views, discussion of incompatible factors, resolution by discussion and/or compromise (i.e., negotiation with risk)		**	
• <u>Planning</u> Formulation of a plan, establishing priorities, selection of alternative courses of action	x		Teleconferencing
• <u>Implementation oriented</u> Administrative activities -- development, assignment of responsibilities for action (delegation of work), scheduling	x		Teleconferencing
• <u>Crisis Decision-making,</u> <u>Crisis Management</u> Speed necessary -- almost instant decision required Travel time allowed	x	x	Teleconferencing

* One major recent study contradicts previously held assumptions about the substitutability of such communication needs. See Chapter 7.

Table 2.3 (continued)

"Substitutable" Communication Needs
(Based On Research Carried Out in the 1970s and Early 1980s)

Communication Need	Substitutable?		Telecommunication Substitute
	Yes	No	
<u>Non-business Communications</u>			
Social services -- including those for handicapped persons	x		Teleconferencing
Education (course)	x		Telecourse
Medical information exchange	x		
Shopping (household)	x (partly)		Teleconferencing
Voting	x		Teleshopping
Personal communications (that normally require face-to-face meetings)		x	Interactive community Television (ICTV)

Most previous research suggests that teleconferencing could be used for about 40 to 60% of all business meetings. The level of actual substitution that would materialize in a given set of conditions is of course the unknown variable. As is clear from Table 2.3, communication needs that result in business travel are diverse in nature. Those with substitution potential can be broadly classified as information transmission and exchange, planning and implementation oriented tasks, and exploratory (problem solving) communications.

A rationale for identification of substitutable and non-substitutable business-related communication needs can be advanced on the following basis:

- (1) Communications for which face-to-face in-person meeting is necessary for reasons shown:
 - nature of task (negotiations, crisis decision-making or decision-making with risk) requires in-person meeting under normal circumstances,
 - necessity of communication atmosphere for in-person meeting (e.g., friendly relations, courtesy, personal contact),
- (2) Communications which clearly require telecommunications services for the reason shown:
 - urgency in decision making (e.g., crisis decision-making, crisis management) and involve only a limited number of participants,
- (3) Communications where communicants are likely to consider trade-offs between face-to-face in-person meetings and telecommunications based on their utility structure. In these cases, tasks to be performed include information transmission/exchange, exploratory, planning, implementation-oriented tasks, and performance review. About one-half of business meetings normally involve these types of communication needs.

Recent research however suggests that transactional (negotiations) types of tasks could be carried out as well through teleconferencing [18]. Should this be true, the effect would be that 70% or an even higher percentage of all business meetings involving travel could potentially be substituted with telecommunications.

A number of non-business communication needs are substitutable (e.g., social services, education, medical information exchange and training, voting, and shopping (for specific needs). Travel for social and recreational reasons is generally regarded as non-substitutable, although interesting observations

have been advanced by some authors which suggest both substitution and stimulation of travel. In addition to the telecommunications-induced travel stimulation for non-business tasks, travel could be stimulated also as a result of implementation-oriented tasks, and negotiations evolving from teleconferencing for business.

2.4 Interaction of Intercity Transportation and Teleconferencing

The interaction of transportation and teleconferencing in terms of the incidence of substituting teleconferencing for travel and/or travel stimulation is shown in Figure 2.3. Such interactions, it is hypothesized, will increase owing to improved teleconferencing systems and services in terms of effectiveness with respect to communication tasks, cost and "user friendly" attributes including convenience. Three types of first order effects are recognized. These are increased overall level of communications, increased share of overall communications traffic served by telecommunications, and the probable acceleration of long term decentralization of office location in urbanized regions [19]. Increased overall level of communications may cause an increase in transportation demand. On the other hand, increased share of overall communications traffic served by teleconferencing modes may result in decreased transportation demand.

As for the long term effects of the trend of decentralized office location decisions, both substitution and stimulation type of effects are hypothesized. It is recognized that as a consequence of decentralization, centrally located public teleconferencing studios may become inconvenient which in turn would make the travel option more attractive. On the other hand, through a controlled development process, clustering of businesses and their proximity to common teleconferencing studios in centralized or satellite-corridor type of developments may enhance the substitution potential. Also, telecommunication-induced decentralization is likely to accompany the installation of in-house teleconferencing facilities by large businesses. The demand for telecommunications is recognized to grow owing to newly generated communication needs, the substitution of telecommunications for travel and the decentralization of offices in large urban regions.

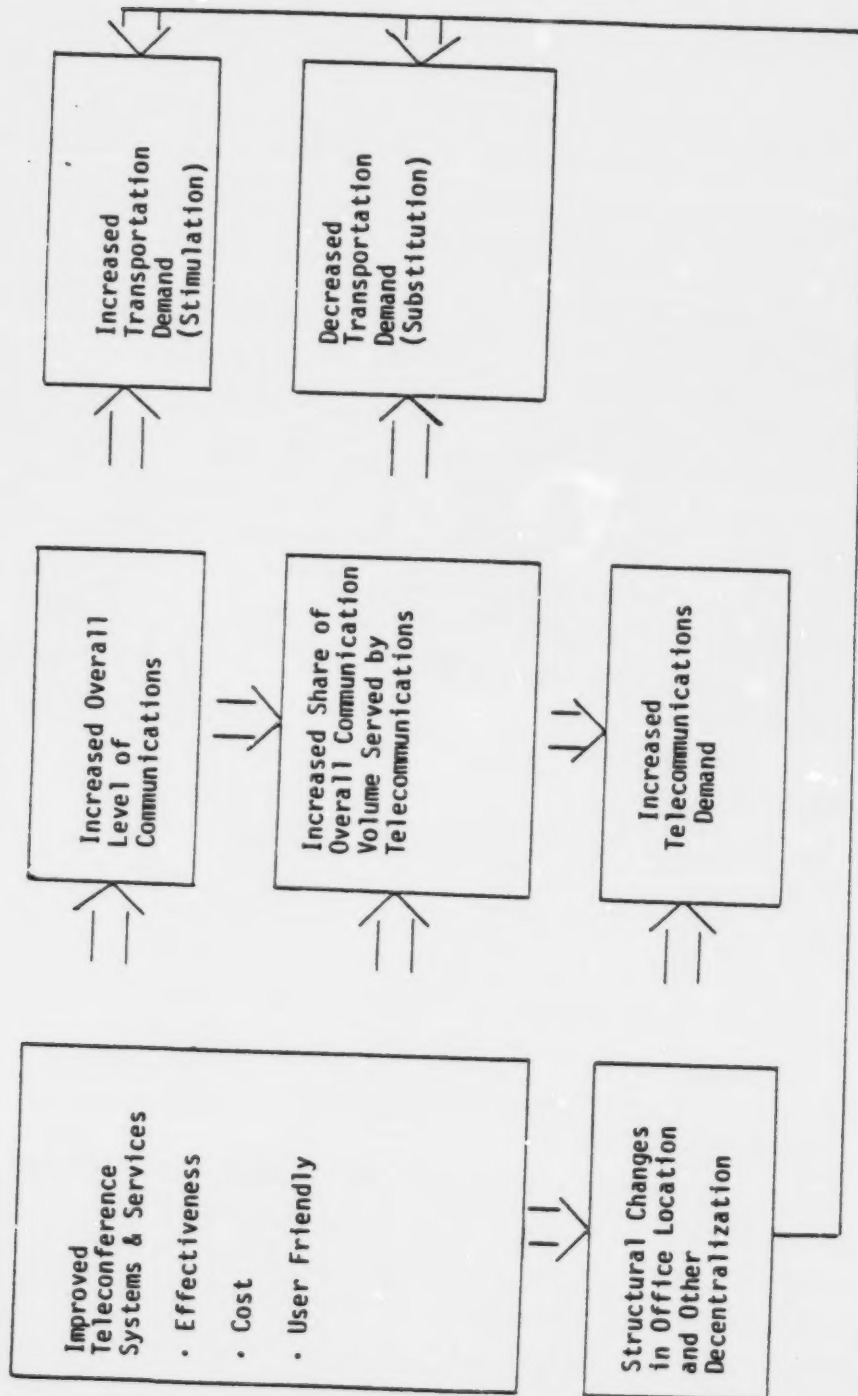


Figure 2.2: Interaction of Intercity Transportation and Teleconferencing

CHAPTER 3

TELECONFERENCING SYSTEMS AND ENVIRONMENT

3.1 Current Modes of Teleconferencing

Teleconferencing and data communication concepts have already been introduced in Section 2.2 of this report. In this section, modes of teleconferencing available in Canada for domestic, trans-border and international communications are described.

This chapter also includes a description of teleconferencing facilities in Canada, carriers, and international developments. Technological developments including performance, capacity and cost trends are covered in Chapter 4.

Teleconferencing modes can be characterized on the basis of primary factors, namely the type of exchange, the message base or medium (i.e., audio, words, visuals), the degree of realism of the video message (i.e., slow-scan, full motion), and the associated bandwidth required. Teleconferencing services available today, whether experimental or permanent range from simple audio facilities through narrowband slow-scan (freeze frame) video systems to full motion two-way colour video with stereo audio capability and complemented by a variety of conference support facilities [14, 20 to 26].

A classification and description of current teleconferencing systems is provided in Table 3.1. These systems are currently used for communication activities in business, government, health and education. Also, ad-hoc or special events use these systems.

A limiting factor in the development of teleconference services is the bandwidth linking the spatially separated participants. Costs of telecommunications are strongly influenced by bandwidth capacity requirements which in essence determines the amount of information that it is capable of transmitting in a

Table 3.1

Current Teleconferencing Systems

<u>Narrowband Systems</u>	
Audio Teleconferencing	Voice-only communication, using appropriate equipment for voice amplification and transmission, in order to enable multipoint communication among individuals and groups. A conference telephone call is the simplest form of audio teleconferencing.
Telewriting	Electronic transmission of writing to remote TV monitors, often through normal telephone lines (e.g., the "electronic blackboard").
Telecopying	These devices transmit page-size photocopies over normal telephone lines or special transmission circuits. Depending upon the equipment and system capability, transmission time could be under a minute to three minutes.
Electronic Mail and Computer-Based Conferencing	These are keyboard text-based group communications media, in which all exchanges take place through a computer terminal. The participants are typically not present simultaneously.
Teletext or Videotex	These are hybrid communications systems that use television technology in a variety of ways to enable access on demand to stored information. These systems offer the flexibility in selecting and viewing the information.

Table 3.1 (continued)
Current Teleconferencing Systems

Slow-Scan (Freeze Frame)	<u>Narrowband Systems</u>
	This system allows still pictures to be transmitted over narrowband channels such as regular telephone network and displayed on monitors in remote locations. In case of transmission (of participants, visual aids, or objects) over the regular telephone network, transmission times range from 6 seconds for low resolution black and white pictures to five minutes for high quality colour.
	<u>Broadband Systems</u>
Slow-Scan Video	It is the same system as described under narrowband systems but often categorized as a broadband system owing to its use of broadband transmission.
Interactive Cable Television (ICT)	It is a mass communication medium with various capabilities and flexibility for audience involvement.
Video Teleconferencing	Capabilities include full motion (compressed and non-compressed) and completely interactive television linking participants on a point-to-point basis, and also full motion point-to-multipoint transmission coupled with interactive audio capability. Transmission is via microwave, coaxial cable, cable television system, and satellites. Also, widespread availability of fibre optics would increase the options for signal transmission.

given period of time. For analog channels (e.g., telephone), bandwidth is measured in cycles per second or hertz (Hz). This measure describes the range of frequencies that can be transmitted. Higher frequency capacity means that more information can be sent through that channel. In the case of digital channels, bandwidth is measured in the number of "bits" the facility can carry in one second (i.e., bits per second or bps).

Teleconferencing systems in general have concentrated on providing information to the hearing and vision senses. With the present technology it is impossible to capture and transmit all the information to the limit of the capacity* of human ear, eye and brain. Bandwidth requirements for a number of current teleconferencing facilities are shown in Table 3.2, which reflect the attempt to control costs of transmission.

Teleconferencing system components can be categorized into two major types on the basis of their bandwidth requirements. The narrowband facilities require voice grade communication facilities (analog bandwidth of 2700 Hz). The broadband facilities require capacity equivalent to 24 to 1500 voice channels.

An explanatory note about television transmission systems would be useful here in understanding teleconferencing concepts. A colour television in analog transmission usually requires 6 Megahertz (MHz) or millions of cycles per second, which is equivalent to 1500 telephone channels. Digital systems of transmission compress the signal to 1.5 Mbps (millions of bits per second) for economy reasons. In a television system, the limitation is caused by the number of individual points in a picture called pixels and the rate at which these points are updated. Naturally, more pixels mean better picture resolution and on the other hand low frequency of updating points would cause the picture to appear "jerkey". A standard broadcast television signal consists of 130,000 pixels, updated 60 times

* The human ear has a bandwidth capacity of 20,000 Hz. The human eye can see frequencies of light in a band of several trillion cycles per second. The human brain can process billions of bits of information per second [20].

Table 3.2
Teleconferencing Systems and Their Bandwidth Requirements

System	Analog Bandwidth	Digital Bit Rate
Audio Conference (Telephone grade)	2700 Hz	64 Kbps
Audio Conference (Broadcast grade)	5000 Hz	80 Kbps
Electronic Blackboard (A T & T)	2700 Hz	1.2 Kbps
Analog Facsimile (2-6 minutes)	2700 Hz	-
Digital Facsimile (30 seconds)	2700 Hz	4.8 Kbps
Freeze Frame Video (9 to 35 seconds per frame)	2700 Hz	-
Full Motion Video (compressed)	-	1.5 Mbps
Full Motion Video (non-compressed)	6 MHz	-

Note: Whenever a system uses primarily analog or digital facilities, the other entry is not shown [20].

per second. In the case of compressed video teleconferencing, rapid motion of participants results in "jerkey" picture [20].

Data communications also play a role in supporting teleconferencing activities. During the past fifteen years, considerable progress has been made in the area of data communications [25,26,27]. The process of developing data networks began with the realization that digital encoding of data (including voice) and digital switching would lead to greater economy and flexibility. As a result, the Trans-Canada Telephone System (now called Telecom Canada) developed the digital dataroute network, with CNCP developing a comparable system termed Infodat. Traditional crossbar switching was gradually replaced with electronic switches, and the next logical move was to a data network which would interconnect main frame computers across the country. In such a network, data is transmitted in the form of "packets", groups of several hundred bytes (characters) which may be routed in the network independent of each other, and reassembled at the destination to form a complete message. All major urban areas in Canada are now linked with data network systems. Major data networks (both voice and data) available in Canada are outlined in this chapter.

3.2 Teleconferencing Facilities in Canada

At present in Canada, while some use is made of telewriting, telecopying, electronic mail, computer-based conferencing, and video conferencing, audio is the most commonly used mode of teleconferencing. Freeze frame and full motion video facilities have been implemented in a limited number of private and public locations. These include: several hospitals, Bell Canada/Telecom Canada, IBM, Royal Bank of Canada, the Federal Government and the Government of Ontario [21,22]. In all these slow-scan and full video type of systems, their technical characteristics as well as conference support devices differ since these reflect the special requirements (needs and constraints) of the implementing agencies.

In spite of a small number of organizations with their own facilities, a surprisingly large number of businesses have tried teleconferencing services.

According to a recent survey, almost three quarters of Ontario businesses are using teleconferencing for business meetings, training programs and special events.

Presently, full motion video is being used for two-way teleconferencing between fixed sites (point-to-point) and for point-to-multipoint teleconferences (i.e., video broadcast to several locations and interactive audio). Owing to switching constraints, fully interactive video teleconferencing is almost exclusively used for point-to-point conferences.* Commonly, non-telecommunications carrier sites must be linked via local broadband to carrier's operating stations. From these stations, the signal is transmitted via microwave or satellite depending upon the locations involved.

Prior to a description of carrier supplied services and case studies, a number of general observations about Canadian teleconference services would be useful.

- (1) Following a period of little promotional activity, during the seventies, common carriers appear to be serious about marketing teleconferencing services, particularly audio services.
- (2) As compared to other provinces, Ontario is the leader -- both in the business sector and public sector. As previously noted, almost three quarters of Ontario businesses are using teleconferencing. About one quarter of Ontario's thirteen universities and one fifth of Ontario's 220 hospitals have teleconferencing experience. The Ontario Government uses teleconferencing and promotes its use through the Transportation Energy Management Program (TEMP). The objectives that were stated for its use include: reduction of travel, productivity increase, extending services, and saving energy.
- (3) Federal Government has also played a direct as well as indirect role in teleconferencing. Through the Department of Communications and other agencies teleconferencing demonstrations were held in the past. Currently, the Government Telecommunications Agency (GTA) is studying teleconferencing in technical terms as well as for means of productivity improvements. The Federal Government plays an indirect role through Teleglobe Canada and to a limited extent through Telesat Canada.

* See Chapter 4 for recent developments in multi-location videoconferencing.

- (4) As for the popularity of services and the use of equipment, the following general observations can be made. Firstly, audio is the most commonly used form of teleconferencing -- operator assisted conference calling, "meet me" services, and private bridges for multipoint conferences. Secondly, telecopies or facsimile machines are very common and there is at least one "electronic blackboard" that is in use at the University of Ottawa. Thirdly, devices for the transmission of graphic or visual material are in limited use. Fourthly, Telidon based videotex technology is in use in a few organizations for the transmission of visual materials to remote sites via the telephone network. Finally, there is a trend toward the installation of dedicated four-wire networks on the premises of some organizations.

3.3 Carriers

Major telecommunications carriers are listed in Table 3.3. Also noted are their characteristics in terms of affiliation, ownership, type of operation and principal territory. Most carriers are members of Telecom Canada. These include: Bell Canada, B.C. Tel, Telesat Canada, Alberta Government Telephones, Saskatchewan Telecommunications, Manitoba Telephone System, Maritime Tel & Tel, NB Tel, Quebec Telephone (non-voting associate member), Newfoundland Tel, and Island Tel, PEI. The telecommunications carriers are either privately or publicly owned, except Telesat which is owned jointly by the private sector and the Federal Government on an equal basis. In addition to these carriers, cable companies also relate to the subject under study. The cable companies are represented by the Canadian Cable Television Association (CCTA).

The Canadian Radio-Television and Telecommunications Commission (CRTC) is responsible for the regulation of carriers that fall under federal jurisdiction. These include: Bell Canada, British Columbia Telephone (B.C. Tel), CNCP Telecommunications, Telesat Canada, Northwest Tel and Terra Nova Telecommunications. Teleglobe Canada, which is Canada's signatory to the INTELSAT and provides international telecommunications services, reports to the Federal Minister of Communications, rather than to the CRTC. Telesat Canada provides satellite communications services and is a member of Telecom Canada [28,29,30].

Regulations for other telecommunications carriers (i.e. those under provincial and municipal jurisdictions) are noted in Table 3.3. The conglomerate Telecom Canada, whose members fall under federal and provincial jurisdictions, itself is unregulated. CNCP Telecommunications, a national company regulated by the CRTC, competes with each member of Telecom Canada. Cable services are regulated by the CRTC. "Non-programming" services on cable are of interest to this investigation.

3.4 Telecommunications Services and Demonstrations

At present, a large number of telecommunications services are available for voice and/or data traffic. These are listed in Table 3.4. For each service, carrier/carriers as well as technical features of services are shown. Additionally, teleconferencing services are also provided by common carriers. Bell Canada's existing teleconferencing services are:

- Conference 100: audio
- Conference 200: dial in or "meet me" type of audio conferencing
- Conference 300: a fully automated audio-conference service rented on a monthly basis
- Conference 2000: audio conferencing, permits two or more geographically separated groups, of up to 20 people each, to meet via the telephone network
- Add-on and three-way calling: it enables the creation of a three-way teleconference in seconds without calling the operator
- Audioplus conferencing: a number of options are available (via telephone network), to enhance an audio only teleconferencing -- by facsimile, electronic graphics, slow-scan or freeze frame.

Teleconferencing services of audio type are also offered by other carriers. Members of Telecom Canada group cooperate in their service offering and rate matters.

Table 3.3
Characteristics of Major Canadian Telephone
and Telecommunications Carriers

Company	Affiliation	Ownership	Type of Operation	Regulation	Principal Territory
Bell Canada	Telecom Canada	Private	Investor-owned	Federal	Ont., & Quebec
British Columbia Telephone	Telecom Canada	Private	Investor-owned	Federal	British Columbia
CNCP Telecommunications		Mixed	Crown Corporation	Federal	Canada
Teleglobe Canada		Public	Crown Corporation	Federal*	International overseas
Telesat Canada	Telecom Canada	Mixed	Investor-owned**	Federal	Canada
Northwest Tel		Public	CNR-owned	Federal	Northwest Territories
Terra Nova Telecommunications		Public	CNR-owned	Federal	Newfoundland
Alberta Government Tel	Telecom Canada	Public	Crown Corporation	Provincial	Alberta
Saskatchewan Telecommunications	Telecom Canada	Public	Crown Corporation	Provincial***	Saskatchewan
Manitoba Telephone	Telecom Canada	Public	Crown Corporation	Provincial	Manitoba
Maritime Tel Telegraph	Telecom Canada	Private	Investor-owned	Provincial	Nova Scotia
New Brunswick Telephone	Telecom Canada	Private	Investor-owned	Provincial	New Brunswick
Quebec Telephone	Telecom Canada+	Private	Investor-owned	Provincial	Quebec
Newfoundland Telephone	Telecom Canada	Private	Investor-owned	Provincial	Newfoundland
Telebec		Private	Investor-owned	Provincial	Quebec
Island Telephone	Telecom Canada	Private	Investor-owned	Provincial	Prince Edward Island
Northern Telephone		Private	Investor-owned	Provincial	Ontario
Edmonton Telephone		Public	Municipally-owned	Municipal	Edmonton

Source: Telecommunications Directorate, CRTC (From CRTC Annual Report, 1981-82) [28].

- * Reports to the Federal Minister of Communications, rather than to the CRTC.
- ** An incorporated company jointly owned by the Government of Canada and the major telephone companies.
- *** Report to the Provincial Minister of Communications, rather than to a regulatory agency.
- + Non-voting associate member.

Table 3.4
Summary of Major Networks

SERVICE	SWITCHED OR NON-SWITCHED	SPEED RANGE			MAJOR CARRIER
		SUB-VOICE (< 300) BAUD	VOICE ($300 - 9600$) BITS PER SECOND	ABOVE VOICE (> 9600) BITS PER SECOND	
Direct Distance Dialing Network (DOD)	Cct Switched	1	up to 1200 async up to 2400 sync		TCTS
Telex	Cct Switched	50 Baud			CNCP
TWX	Cct Switched	up to 110 Baud			TCTS
DataTelex	Cct Switched	up to 180 Baud			CNCP
International Telex	Cct Switched	50 Baud			Telelobe Canada
Multicom 1	Cct Switched		up to 1200 async up to 2400 sync		TCTS
Broadband Exchange Service	Cct Switched		up to 9600 BPS	up to 48KBPS	CNCP
Multicom 2	Cct Switched		up to 4.8KBPS		TCTS
International Data 600	Cct Switched		600 BPS		Telelobe Canada
Multicom 3	Cct Switched			up to 50KBPS	TCTS
ICAS	Packet Switched	300 Baud	1200 Baud		Telelobe Canada
Telenet	Message Switched	1	1	1	CNCP
Autocom	Message Switched	50 Baud			Telelobe Canada
Infodat	Non-Switched Digital	1	1	up to 56KBPS	CNCP
Dataroute	Non-Switched Digital	1	1	up to 56 KBPS	TCTS
Datapac	Packet Switched	1	1		TCTS
Infoswitch	CCT Switched, Virtual Connection, Packet Switched	1	1	1	CNCP
Alta-Net	Not-switched		up to 2400 sync.		A.G.T.
Computer Message Switching Service (CMSS)	Message Switched	1	1	1	CNCP

* a full range of speeds available

- Notes: 1. TCTS is now called Telecom Canada.
2. Other services such as Envoy 100 are available as well.

Source: Canadian Telecommunication Carriers Association (1979)

Bell Canada offers videoconference services as well. Conference 600 is a two way, fully-interactive point-to-point audio and video conference service for groups of up to six people in carriers' conference rooms at each of two locations. Conference 600 alternatives are available as well. That is, customers can use Bell Canada's conference rooms (available in Toronto, Montreal, Ottawa, Quebec City or Bell Canada could be asked to install its portable equipment in conference rooms on the customer's premises depending on network availability. This service is available in centres noted above and also in Hull, Thunder Bay, and London, Ontario. Bell's Conference 650 is a point-to-multipoint conferencing for groups of 20 to 200 in various locations. It enables one-way video transmission from the prime location, and two-way audio between all the locations.

Two new telecommunications services were recently implemented by Telecom Canada. The Stratoroute 2000 is a satellite-based integrated digital communications service designed to provide medium-to-large size Canadian organizations with a multifunctional network in support of their corporate voice, data and image communications traffic between Canadian cities. The second service, Conference 600 is a satellite-based, two-way, interactive colour video conferencing service. It is intended to allow small groups to conduct (point-to-point) conferences. It is claimed to be the only teleconferencing service that provides visual feedback from all participants. Conference 600 will be implemented in stages. At present it is available in Calgary and Toronto and will be extended to other cities in the period of 1984 to 1987. Ultimately a total of 19 Canadian cities will be served.

Teleconference services are available to the U.S.A. and other selected destinations in the world. Telesat Canada, which is Canada's satellite telecommunications carrier offers transborder satellite telecommunications services including video teleconferencing. Telesat Canada cooperates with Canadian common carriers and U.S. Domsats in the supply of transborder services. For instance, Telecom Canada's Conference 600 service has been interconnected with a compatible service in the U.S.A.

Teleglobe Canada, which is Canada's signatory to INTELSAT, presently provides satellite facilities and a studio in Toronto in support of international videoconferencing. Present focus is on intracorporate video conferencing. Until recently such services were not found to be cost-effective due to the application of the then applicable space-segment and terrestrial tariffs. Through new technology development, namely digital signal processing techniques, higher power satellites, lower cost earth stations, and technologies for integrating various communication services (voice, data, video) over a single communication link to end user, has reduced the costs.

Phase I of Teleglobe's international teleconferencing program involved the use of existing technologies and public conference studios in Canada and Europe. In Phase II, additional enhanced service features and advanced technologies have been incorporated. That is, latest developments have been incorporated in the areas of digital video compression, telewriting, freeze-frame TV, and 14/11 GHz satellite transmission in order to lower transmission costs. Thus, lower end to end tariffs have been achieved through lower cost facilities. As a part of Phase II activities, Teleglobe has constructed a conference room (studio) in downtown Toronto. This facility is considered to be the corporate conference room of the future since it incorporates local conferencing and international teleconferencing capabilities and the flexibility to select combination of conference support facilities among telewriting (i.e, electronic blackboard), facsimile, freeze-frame TV and high resolution graphics display. Depending upon the success of Teleglobe studio in Toronto, similar studios could be established by the corporation in other major centres such as Montreal and Vancouver. It should be noted that customers with private teleconference facilities could have access to Teleglobe services over leased lines.

Three main categories of applications of teleconferencing have already been introduced. Educational, health and government services applications are interesting to outline here. A number of universities and educational institutions are using teleconferencing systems for transmitting educational programmes. These are: University of Ottawa, Carleton University, Algonquin College (Ottawa), University of Quebec, University of Saskatchewan, Ontario Educational Communications Authority, and B.C. Ministry of Education. Other universities and institutions

with teleconferencing experience include: University of New Brunswick, Atlantic Provinces Association for Continuing University Education (APACUE), Dalhousie University, Acadia University, University of Calgary, The Knowledge Network of B.C. (involving University of British Columbia, Simon Fraser University, University of Victoria, and B.C. Institute of Technology). Telemedicine has been an area of considerable interest and activity in Canada. In addition to over 20% of Ontario's 220 hospitals (including health services of the University of Western Ontario), health services associated with the Memorial University of Newfoundland operate or participate in teleconferencing services. Systems designed are audio, electronic graphics and freeze frame types. Governments of Canada and Ontario have tested teleconferencing systems (audio, video, electronic graphics and Telidon-based videotex).

Governments of Canada and Ontario have an active interest in all modes of teleconferencing. In Ontario, while audio teleconferencing is used most extensively, a full motion system is also available. In cooperation with the Federal Department of Communications, teleconferencing experiments were carried out over the past decade involving satellites and other communication system components in order to test facsimile, freeze frame, and full motion video conferencing services. Consequently, the Ministry of Government Services (MSG) installed a colour, full motion video system for a number of reasons including specific applications requiring face-to-face teleconferencing (e.g., psychiatric interviews). Currently, the system links Toronto with Thunder Bay, Oshawa and Sudbury. It is used approximately 8-10 hours/month, but its use is likely to increase as a result of promotional endeavors.

Federal Department of Communications had demonstrated the use of teleconferencing for over a decade now. In a recent trial in Eastern Canada, rooms were equipped in Ottawa, Moncton, St. John, New Brunswick, and St. John's, Newfoundland with audio, freeze frame video and Telidon (videotex) equipment. Personnel from various departments participated in point-to-point and multi-point demonstrations. Results indicated that although the technical quality of the videotex/Telidon system was found to be impressive, freeze frame video was regarded to be of more use. The Government Telecommunications Agency (GTA) within the Department of Communications plans and arranges teleconferences for federal government departments and agencies.

In spite of the high cost of teleconferencing involving satellite transmission, ad hoc teleconferencing is gaining popularity in Canada and the U.S.A. In 1982, over seventeen point-to-multipoint conferences took place in Canada. -Forty to forty five percent increase for 1983 was forecasted by Canadian Teleconference Network Inc. [32,33].

Over two-thirds of ad hoc conferencing in 1982 originated from the U.S.A. This trend is likely to continue in the future. Reasons for the growth of ad hoc teleconferencing include the desire of U.S. based companies to reach Canadian markets at a small extra cost, improved transborder transmission arrangements, the availability of professional turnkey operators and equipment suppliers (e.g., companies such as Canadian Teleconference Network Inc.), and the availability of facilities at large U.S. hotel chains (e.g., Holiday Inn, Hilton, Marriott, Intercontinental). According to news items in the literature, major Canadian hotels are seriously considering the installation of permanent facilities and equipment.

Ad hoc teleconferencing permits the participation of large groups and is suitable for such events as new product introductions, press conferences, training seminars, and annual meetings. Examples include the introduction by Ford Motor Canada of its new 1983 product line in six major cities, Premier of Ontario's message transmitted by satellite to other locations, and the annual meeting of the Canadian Association of Science Writers involving Canada-wide participation of members [32,33].

There are other types of occasional teleconferences which involve point-to-point communications. For instance, on December 5, 1983, through an unprecedented teleconferencing arrangement linking the Supreme Court of Canada in Ottawa with lawyers in Vancouver, the Court heard six applications (in less than two hours) seeking leave to appeal British Columbia court ruling.

The event was considered a technological and legal success. The experiment sponsored by the Supreme Court, Canadian Bar Association and the Federal Justice Department, was designed to reduce costs and improve access to the Supreme Court. Court procedures now require lawyers from outside Ottawa to present their cases in person. According to the sponsors of this demonstration, a

barrier to routine use of teleconferencing is the cost of renting the satellite channel, which at present costs about \$3,000 per hour. Under favourable cost conditions and also favourable response from the participants, the system could be expanded to nine other centres across Canada [34].

Through the formation of Teleconferencing Association of Canada in December 1982, an additional source of information on teleconferencing has become available. The objectives of this organization include the enhancement of public awareness of its users and benefits, the provision of a forum for discussion of the new technology and implications of technology use, and representing Canada internationally.

The use of teleconferencing by Canadian businesses has already been noted briefly. While a substantial number of businesses have audio conferencing capability, there are only a few videoconferencing studios on customer premises. These include studios belonging to Bell Canada, IBM and Royal Bank. Alberta Government Telephones has recently developed studios as well.

Bell Canada has developed audio plus freeze frame video facilities (mainly for company business) in Ottawa, Toronto and London (Ontario). This type of service is planned to be implemented in Montreal and Quebec City as well. Full motion video services of Bell Canada and Telecom Canada have already been noted in this chapter.

IBM Canada experimented with video conferencing by linking two sites that were less than 2 kilometers apart prior to the development of its present system. Its present system links Toronto and Montreal and is supported by a variety of visual aids including freeze frame. Studios can accommodate up to nine participants. The system is used approximately 3-5 times per week, primarily by marketing personnel and by senior managers. Meetings are typically less than three hours in duration and involve 3 to 4 persons at each site [21,22,32].

Royal Bank of Canada has a colour video conference system which links its Montreal headquarters with Toronto. A third location can be added via audio only. It provides freeze frame capability in addition to high quality audio signal. Prior to the development of the present system, Royal Bank used an audio conferencing system connecting Montreal and Toronto. The system is used approximately 35 hours per month by middle management and executives [21,22,32].

3.5 International Developments

As in Canada, in a number of other countries in the world as well as between countries, a variety of teleconferencing systems are being tried [35 to 40]. Also, the applications of satellite and digital communications technologies are on the rise. The U.S.A. is clearly the leader in teleconferencing technology as well as its applications. A recent survey of 147 organizations in the U.S.A. shows that 57 percent have audio teleconferencing facilities. Percentages of other teleconferencing modes are: audio and audiographics 12%; audio and freeze frame video 8%; audio, freeze and audiographics 8%; audio, full motion video 12%; audio, full motion video and other 3%. Surveys also suggest an increased trend towards freeze frame video and full motion video complemented by other devices [41].

In respect of the overall number of U.S. organizations with their own facilities, the figures are much more impressive than those of Canada but these amount to only a few hundreds. The exact number is not known at this time.

Teleconferencing services available in the U.S.A. cover the whole spectrum of options (e.g., A T & T's services). Satellite technology based networks development by such corporations as Satellite Business Systems (SBS), AMSAT, and others are being used for video, voice and data traffic with earth stations and facilities located on customer premises. Major users include companies such as MA/COM, IBM, Xerox, ARCO, Boeing, and J.C. Penny. At present, SBS offers video teleconferencing from the U.S.A. to the U.K. and to Italy. The SBS uses INTELSAT satellites for its video conferencing and other business services.

Satellite teleconferencing involving point-to-multipoint transmission of special events is growing in popularity in the U.S.A. Major hotel networks (i.e., those of Holiday Inn, Hilton, Marriott, Inter-Continental) offer their premises and transmission systems for such occasional teleconferencing. About a dozen companies are involved as equipment suppliers and turnkey operators in this type of teleconferencing (e.g., Netcom Satellite Services).

In addition to business applications, there are numerous examples of education, health care and other public service applications of teleconferencing in the U.S.A. (e.g., the University Campus Network).

In aggregate terms, estimates suggest that less than 1 percent of all U.S. companies (business and industry) currently use teleconferencing (other than three way conference calls) on a regular basis. There are other surveys however that suggest that as high as 84% of the Fortune 500 companies plan to install their own teleconference systems [13,14].

Teleconferencing is also of interest to most European countries, which are testing or installing digital networks as well. In a cooperative venture, several European countries are testing international teleconferencing in association with Teleglobe Canada. In support of this activity, the countries involved have developed and are testing a compressed video codec for full-motion video and graphics. The compatibility of this innovation (device) with North American standards is presently being tested in association with Teleglobe Canada. Countries participating in the European Videoconferencing Experiment (EVE)* are: U.K., France, West Germany, Italy, and the Netherlands. Observers to this project include four other European countries (namely Belgium, Finland, Norway and Sweden) and Eutelsat -- the Organization for European Satellite Telecommunications.

* EVE evolved from the activities of CEPT (Conference European de Postes de Telecommunication) in response to the objective of establishing a European network as a first step in creating a standardized international video conferencing service.

The British Telecom International (BTI) is active in finding means to reduce costs and providing new services (e.g., X-stream digital services that include Megastream for voice, data, and videoconferencing as well as Satstream for integrated services with other European countries). Additionally, the BTI's "Mercury" service, planned for implementation is regarded as a major development service since it is a new high-speed digital joint venture activity of cable and wireless, British Petroleum, Barclays and Merchant Bank.

The European countries are active in demonstrating the feasibility of international teleconferencing. The successful demonstration of international teleconferencing carried out by the BTI and the SBS (U.S.A.) was mentioned above. An outcome of this demonstration is the announcement by SBS to offer full motion video teleconferencing to several of its customers as an extension of their domestic SBS-supplied service.

In addition to satellite transmission, other means are under consideration for trans-Atlantic transmission of video conference traffic. A T & T has proposed a full colour full motion teleconferencing system based on undersea cable transmission.

Interest of individual European countries in teleconferencing varies considerably. Activities in U.K., France and a number of other countries in developing a European network have already been noted. Both France and the U.K. have domestic audio and video conferencing services (on a demonstration basis). In Denmark, teleconference services are limited to audio type since video conferencing has not been considered by any administration. In Sweden, teleconferencing (including video conferencing) has been offered since 1979 and there are presently studios available in Stockholm and four other cities. However, the video services have not aroused much interest on the part of the businessmen.

A number of other European countries report research into teleconferencing. These are: Norway, Holland, Switzerland, Belgium and Finland.

Japan, in addition to testing teleconferencing innovations, is pushing towards service integration (i.e., Information Network System -- INS). Presently, owing to transmission capacity requirements of full-motion video, a separate network has been set up. Eventually, the Nippon Telegraph & Telephone (NTT) anticipates the integration of visual communications in the INS.

Australia has been active in researching teleconferencing for over a decade. It has gained considerable experience in conference television type of service owing to a number of demonstrations.

Further description of international teleconferencing in terms of technology developments is provided in Chapter 4.

3.6 Developments in Telecommunications Regulatory Policies

In 1966-67, the National Transportation Act authorized the Canadian Transport Commission to regulate telecommunications in Canada. This authority was transferred to the CRTC through the CRTC Act of 1976. This commission is authorized to exercise powers and perform the duties and functions in relation to telecommunications, other than broadcasting, in accordance with the Railway Act or any other Act of Parliament which vested powers in the Canadian Transport Commission and the President thereof. CRTC regulations of common carriers derives largely from section 32(1) and (2) of the Railway Act [30,42].

The Minister of Communications is responsible for a large number of Acts, the following being the most relevant to this research:

- The Department of Communications Act
- The Telegraphs Act
- The Canadian Radio-television and Telecommunications Act
- The Teleglobe Canada Act
- The National Transportation Act
- The Telesat Canada Act
- The Radio Act
- The Railway Act
- The Broadcasting Act

The jurisdiction of provincial governments over a number of telephone/telecommunications companies has been noted above. In a mixed jurisdiction regulatory environment, it is logical that telecommunications will be influenced by policies of both levels of government [43 to 46]. Edmonton Telephones is the only company that is regulated at the municipal level.

In response to technological change and market requirements, federal regulatory policy in respect of telecommunications has been gradually shifting toward increased competition over the past decade. As a result of CRTC decisions, a reasonable degree of competition evolved in respect of the supply of equipment attached to telephone lines, in the long-distance transmission of non-voice (usually data) traffic, and in the supply of private lines. CNCP Telecommunications was allowed to provide telecommunications services by interconnecting with Bell Canada facilities. CNCP Telecommunications has recently proposed further steps and arrangements towards increased competition in the market.

New interconnection and attachment regulations are believed by industry analysts to be a factor contributing to the decline in the cost of equipment. These regulations allow attachment of certified terminals to common carrier facilities and networks -- thus resulting in a competitive equipment market.

Another development of interest to this research relates to cable services. In late 1981, the CRTC approved cable's "non programming" services on an experimental basis. These services, among others, include customer requested information services, videotex, and teleshopping. A number of issues are associated with these services. These are: the incidence of cost (user vs. supplier), equitable regulation of cable companies vis-a-vis telecommunications carriers, and equitable access to these new services. For instance, in the case of teleshopping, the CRTC expects the costs to be borne by both information providers and subscribers. On the issue of equity in regulation, telecommunications carriers suggested that "non programming" services by cable should be regulated in the same way as those supplied by them (e.g., rate of return considerations).

Equitable access to cable systems relates to the intention of third parties to provide non-programming services in return for a fair price. Through public hearings the CRTC intends to assess the technological, economic, social and cultural impacts of these services.

A number of other CRTC decisions were pro-competition. In one of these, the CRTC approved terms of access and associated tariff schedules for the use of Bell Canada's facilities by cable operators. In another decision, Telesat was required to offer partial channels to the common carriers. In turn Bell Canada and B.C. Tel were required to offer services provided by partial satellite channels at tariffs insensitive to distance and number of sites served.

A number of policy issues remain. These are noted below in summary form.

- (1) Regulation is used for achieving broader objectives, namely distribution of income among classes of buyers of regulated services, and national unity objectives.
- (2) There is cross-subsidization of local services at the expense of toll rates. According to available estimates, each \$1 of toll revenues costs only \$0.43 to produce whereas local services cost \$1.84 to produce each \$1 of revenue. Deregulation of the long distance market resulting in entry of other carriers might cause a drop in toll rates and a rise in the local service charges.
- (3) Further interconnect opportunities have been requested by CNCP Telecommunications.
- (4) The membership of Telesat Canada in the Telecom Canada conglomerate prevents possible competition between the telephone companies' systems (including satellite use) with direct use of satellites by other common carriers. The CRTC was against such membership on the basis of public interest criterion but was overruled by the federal cabinet.
- (5) The CRTC is faced with the question of whether Telesat's unique services should be regulated differently than other telecommunications carriers. Telesat is faced with a stagnating satellite industry and excess capacity. It requested higher rates as well as a faster moving regulatory environment in order to be able to lease capacity to U.S. customers. It is interesting to note however that users of satellite services claim the existing rates

to be too high. According to some authors, the Federal Government's policies for regulating satellites is impeding the accelerated adoption of full motion video teleconferencing facilities.

In the U.S.A., the matter of terminal and system interconnection was settled a few years earlier than in Canada. At present, the FCC is deregulating the industry. This development has resulted from the passing of recent bills to revise the Communications Act of 1934, and the settlement of the A T & T antitrust suit. Deregulation has resulted in diversity of service and entry of new carriers into the market. International telecommunications business has become more competitive under the effects of deregulation [48 to 52].

Deregulation policies in the U.K. have prompted British Telecom International to diversify services and lower tariffs. However, in European countries the PTT's enjoy monopoly power. Their conservative and often nationalistic policies governing the implementation of new services and pricing of these services have been reported by Canadian and U.S. international carriers to be roadblocks to teleconferencing in the past.

As compared to the U.S.A., Canadian industry is considerably regulated and Canadian rates are higher for long distance. Moreover, the industry structure is different.

CHAPTER 4

TECHNOLOGICAL DEVELOPMENTS: CURRENT STATUS AND FUTURE PROSPECTS

4.1 Introduction

Here, in this chapter, technological developments are assessed in terms of performance, capacity and cost trends of telecommunications systems including developments in teleconferencing modes and their technical capabilities. Performance and capacity trends are reported in Section 4.2. Available information on changes in costs and tariffs is presented in Section 4.3. An analysis of technical developments presented in this chapter is intended to go beyond the description of teleconferencing modes and services provided in Chapter 3.

Technology developments assessed here point to the direction of increased availability, improved quality, reduced cost and increased convenience of telecommunication systems and services. However, further developments are needed during the 1980's and early 1990's in order to offer enhanced communications. Details are presented below.

4.2 Performance and Capacity

4.2.1 Technical Developments

Audio conference systems which started with speaker phones, are expected to evolve to full stereo transmission with close approximation of physical presence. Also, these systems are likely to be available widely at reasonable cost. At present sophisticated arrangements for audio conferencing are available in the market place (e.g., digital type of new audio teleconferencing products,

Dedicated			
Audio Conference System	Dial Up	Operator Assisted	
		Telco	Direct Dial Conference
		Meet-Me	In house
		Vendor	
		PBX	

Figure 4.1: Audio Conference System Configurations

hands off microphone, open mikes at both ends, echo-free sound systems, flexible and advanced bridging arrangements, and private facilities with dedicated lines). Other developments that affect audio conferencing systems as well as other conferencing modes are noted later in this section [13,14, 53 to 58].

Audio plus graphics support, computer support and freeze-frame (slow scan video) are narrow band conferencing modes. In these systems, a wide variety of features are involved. These include document transfer devices and telewriting (i.e., electronic note pad or blackboard).

Currently, many different types of facsimile systems are in existence with transmission rate varying with the quality of resolution and the amount of information per page, (e.g., NASA's system which uses a 56 kbps satellite circuit has a maximum rate of six seconds/page). Another innovation is the Facsimile Intelligent Communications Systems (FICS) of Nippon Telegraph and Telephone (Japan), which employs existing telephone network, and enables reception of information by an automatic reception circuit. The user of this system can access the information whenever desired. The FICS type of system can be used to transmit printed (even confidential) information prior to or at the conclusion of a teleconference. Also it enables transfer of information for storage [13,14].

Future developments include high speed document transfer and integrated graphics projection.

Computer support for conferencing could involve communicating word processors, data terminals, message systems, computer conference scheduling, and future integrated information transfer and retrieval system. A special feature of keyboard conferencing is that there are no time restrictions on a computer conference (i.e., the participants need not respond immediately).

Narrow band teleconferencing has evolved into a practical, reasonably low cost mode for a variety of applications. Freeze-frame video requires less bandwidth as compared to compressed or full video systems. The quality of resolution depends upon the design and cost of equipment. Future developments

Audiographics	Graphics Mode	Facsimile	
		Telewriters	Light Pen
			Blackboard
			Tablets
		Microfiche	
		Computer	
		Freeze Frame	
		Hybrids	
Computer Conferencing	Star Networks (Hub or Central Point)	Micros	
		Minis	
		Main Frame and Terminals	
	Local Ring Networks (Intra Building Complex)	Micros	
		Minis	

Figure 4.2: Audiographics and Computer Conferencing Systems

(mainly from cost reduction viewpoint) include compression techniques applied to freeze-frame video and associated audiographic systems [59,60].

Video systems fall into three categories. These include: freeze frame, compressed video and full motion video.

Video systems include voice communication and graphics as well as images of participants. Freeze frame system has already been introduced in Chapter 3 and above. Compressed and full motion video systems fall into two major categories. One of these is a two-way fully interactive video (linking two-sites) with add-on one-way video and two-way audio capabilities. The second type of system is multi-location type which allows one-way video and two-way audio transmission. Such systems are commonly used on an ad hoc basis.

Videoconferencing systems have recently become available in Canada for domestic and international use -- although on a limited scale. Telecom Canada/Bell Canada offer such services (e.g., Conference 600) for domestic use, and interconnection with a compatible service in the U.S.A. for trans-border use [62,63]. Teleglobe Canada provides video services between Canada and the U.K. (and France) by combining the best features of the various conferencing methods (i.e., audio, video and graphics) [64 to 67]. The number of cities connected are, however, limited at present. Chapter 3 describes these services and future expansion plans.

Videoconferencing, in the past, faced numerous cost, quality and other constraints. These include: full bandwidth requirements, broadcast video standards required for international conferencing, interconnection difficulties due to different standards in various countries, and lack of wideband capacity for international conferencing during limited number of compatible hours. Technological developments have overcome these constraints to a large extent. Notable among these include: higher power higher capacity satellites (operating in the frequency bands about 10 GHz), improved small size earth station designs, installation of earth stations close to end users, and time division multiple access (TDMA) for satellite capacity use.

Freeze Frame (Slow Scan)		
Videoconferencing	Compressed Video *	Two way fully interactive video (linking two sites with add-on)
	Full Motion **	One-way video and two-way audio capabilities One-way video two-way audio multi-location

* Technology is still developing, occasional blurring.

** Broadband, no compression.

Figure 4.3: Videoconferencing System Configurations

Other developments that will enhance video conferencing potential include: video compression devices, availability of conference rooms with minimum amount of access time, mobile facilities at short lead time, computer and videotex applications in videoconferencing, and fibre optics (e.g., digital fibre-optics systems for long haul transmission).

Future developments in video conferencing systems include local access systems (including conference room access), high quality video (resolution) and stereo sound, life size screen projection, improved conference rooms (studios that offer higher quality conferencing at lower costs than existing studios), and two-way interactive multi-link systems -- a feature many consider essential for effective communication. It should be emphasized that local access systems are regarded as highly desirable since carrier supplied studios are not necessarily convenient for many potential users.

In addition to high capacity local lines, regular satellite access by most organizations is likely to be feasible provided that teleconferencing is regarded as one of the users of such facilities. It is unlikely that teleconferencing alone can justify high costs of regular satellite access.

Recent research reports suggest the feasibility of multipoint videoconferencing. Presently two main methods are available which can be used to link multi-locations for video conferencing. In the "continuous presence" method, the picture resolution in moving areas is temporarily reduced since aggregate data of all signals (from all locations) is limited to one video channel (of 1.5 or 2.0 Mbit/second capacity). Considerable research is required in the continuous presence multipoint scheme prior to its implementation. On the other hand, the switched multipoint arrangement (which permits viewing by one location of one other location at any time) is almost ready for commercial implementation. For example, the cost 211 codec (developed in Europe) is designed for "switched" multipoint operation incurring minimal overheads via a Multipoint Control Unit (MCU). Also, experimental results in Japan suggest that a newly developed Multipoint Communication Control Equipment (MPCE) can link up to four-party meetings [68,69,70].

Other future developments that will enhance the cost, quality and availability of all conferencing modes include: developments in automated office (including audiographic work stations with desk-to-desk or desk-to-conference room teleconferencing, voice recognition and numerous other innovations), mobile phone, local area network (LAN), digital communications, and Integrated Services Digital Network (ISDN) in association with satellite technologies (for voice, data and video services) [71 to 90].

Sharing the use of space segment and earth stations for video, voice and data transmissions can result in improved capacity utilization and reduced cost. See Figure 4.4 for an illustration of a telecommunication network components that are shared by Conference 600 (video conference system), Stratoroute 2000 (voice and data system), message toll, occasional use video and "special facilities" tariff services.

Clearly, teleconferencing services inaugurated in 1983, namely Telecom Canada's Conference 600 and Teleglobe's Canada-Europe Video Conference service (i.e., CONFRATEL) are advanced systems. However, future products and services are expected to be even more sophisticated and widely available. As noted earlier, real advances are expected to occur in the form of integrated services digital networks (ISDN).

As for further advances in digital video compression and transmission techniques, it is probable that before the end of the 1980's, these advances will reduce transmission speeds to perhaps a quarter of their current level (i.e., 300 - 400 Kbits/second vs. 1.5 - 2 Mbits/second).

4.2.2 International Teleconferencing

Initial trials of international videoconferencing used analog broadcast TV links which required capacity equivalent to 1000 telephone circuits. Through the digital coding bandwidth compression method, transmission capacity requirements were reduced substantially. The cost 211 project in Europe (a

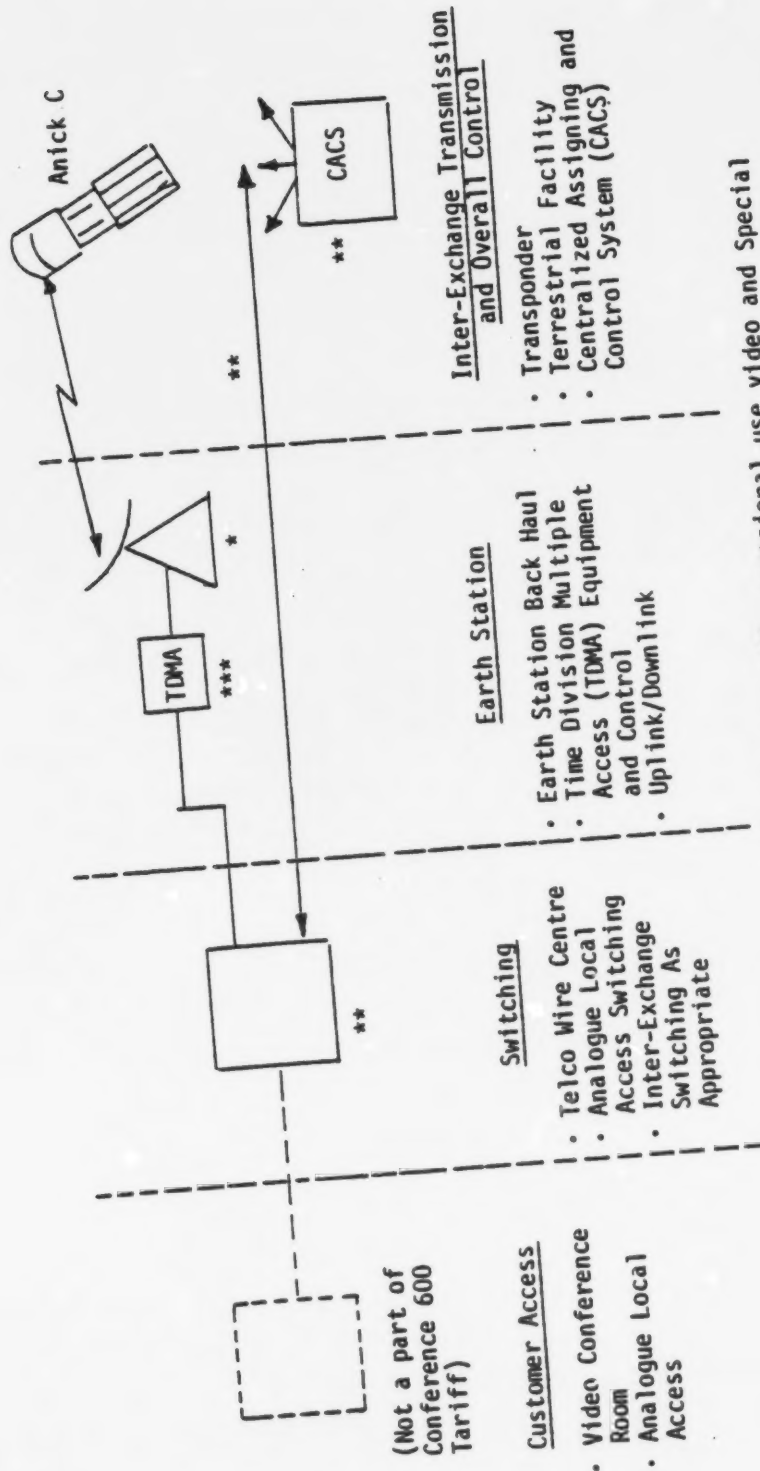


Figure 4.4: Conference 600 Network Components and Shared Facilities (Reference 63)

collaborative research project in Europe) resulted in such a commercially available product (i.e., compatible video codec) which converts sound and full motion colour pictures into digital form. Capacity requirement for this form of video transmission is 2 million bits per second (2 Mbits/second) -- the equivalent of 30 telephone circuits.

One of the major constraints to the development of international video-conferencing services has been that of divergent technical standards [35, 91 to 94]. That is, TV standards, video codecs and digital networks differ in many countries. Through research, problems of compatibility have been overcome. For instance, the UK codec developments now permit coding/decoding either the European 625/50 Hz/PAL and SECAM TV signals or the North American 525/60 Hz/NTSC signals and to output any signal source desired at either 2.048 Mbits/second (which is European standard) or 1.544 Mbits/second (North American standard) [91]. Clearly, perfecting the compatibility of European and North American standards by Canadian, U.S. and European carriers, international teleconferencing services will be facilitated.

4.3 Costs and Tariffs

An examination of selected (system, components) costs and tariffs is presented here for the following reasons. Costs of customer owned facilities at various utilization levels give an indication of the expense of conferencing. Cost trends might give an indication of whether there are prospects of a drop in user charges. Tariffs are of course, an important element in the study of travel vs. telecommunications tradeoffs.

Costing teleconferencing systems and services is, however, a complex topic. In this research, such an endeavor is not intended. The CRTC has been conducting an inquiry in order to determine, for its regulatory purposes, a costing methodology for existing services. This inquiry was initiated in response to a concern that carriers may price their competitive services below cost. In the present study, available cost and tariffs information has been incorporated in trade-off analyses.

In general, costs of video teleconference network components have been dropping (and are expected to drop further) owing to technological developments. Major specific reasons include:

- satellite facilities, with their broadcast capability and distance-insensitive nature, are well suited to video conferencing -- both in cost and quality terms, particularly when used in conjunction with time division multiple access (TDMA) equipment,
- advances in picture processing technology have resulted in digital compression of the video signals by about 60 times -- a significant reduction in bandwidth requirements and consequently transmission costs; space segment charges could be reduced by a factor of five or more,
- provision by the local telephone companies of local access to telco-located picture processors at reasonable charges; such access loops would be required by the private and public conference rooms,
- shared use of telco-located picture processors by the users would reduce cost of conferencing,
- high capacity satellites, powerful antennas, multi-purpose network components shared by video, voice and data applications,
- leasing arrangements for conferencing equipment,
- reduction in space segment costs for freeze-frame video (56-256 kbps range) through compression techniques,
- low cost earth stations.

Audio teleconferencing is, in general, the least expensive mode of conferencing (e.g., the simple telephone conference call). However, multipoint systems with sophisticated equipment and conference rooms may cost many thousands of dollars. Cost items involved are: location equipment, carrier transmission, bridging/interconnection, and conference rooms. Examples of equipment and other costs illustrate order of magnitude figures. An audio terminal may cost from around \$100 to over \$3,000 per location. Equipment may be leased and/or bought [13, 57,58].

Network options (for audio conferencing) include regular telephone network, a private network, and CNCP Broadband network. Network costs depend upon configuration, frequency and other uses of the facilities. A private (dedicated) network is costly unless frequency of use is high. Conference bridges are required to connect three or more locations (e.g., over fifty) for multi-point conferences. A wide variety of bridging services and equipment is available at varying costs. Options include: public bridges, (i.e., Bell Canada, CNCP Broadband Conference Operator, third party commercial services (U.S.A.)), and private bridges (i.e., "stand alone", PBX-installed). Toll charges per hour (station-to-station call rate during regular billing hours) on a national and regional basis amount to [57,58]:

TCTS (Telecom Canada) Conference 100 (operator):

\$342.27 (National)

\$ 95.40 (Regional -- Toronto-Ottawa-Kingston)

TCTS (Telecom Canada) Conference 200 (Meet-Me Service)

\$386.06 (National)

(124.41 (Regional)

Approximate cost of a Meet-Met Bridge is \$2,725.00 + \$500.00 installation charges.

Costs of electronic graphics depend upon the type of equipment. Likewise, costs of slow-scan or freeze-frame video are usually affected by requirements for quality colour and speed of transmission.

Computer conferencing is in general a low-cost form of communication. Its costs include those of a computer terminal, a communication modem to connect a telephone line, and a charge to have an account with a conference service. Typical U.S. prices (low end of the scale) are: \$1,000.00 for a computer terminal, \$100.00 + for a modem, \$50.00 for one-time service charge and \$25.00 per hour service charge.

Video conferencing studios vary considerably -- reported costs vary from \$25,000.00 to \$600,000.00 per location. The differences are due to quality of equipment, transmission channel and room design. In comparing compressed video and full-motion video systems, the cost differences are mainly due to picture processing equipment and transmission channel charges. Picture processing

equipment is costly at present -- about \$200,000.00. However, transmission charges can be reduced to one-fifth the cost of full bandwidth (e.g., \$20,000.00/month vs. \$100,000.00/month in the U.S.A.). In the U.S.A. transmission charges for digital network services, per hour of use, are \$1,080.00 for a 3 megabit link and \$540.00 for a 1.5 megabit channel. These charges, of course, do not include network access charges. Unless shared by many users, a Network Access Centre (earth station) dedicated to a single customer costs \$17,500.00/month (U.S.).

High cost of developing private video conferencing systems and high transmission charges necessitate extensive usage level for reasonable cost per teleconference. Logically, only large organizations with high intra or inter-organization communication needs may find it attractive to look into the feasibility of private facilities. There are of course, less expensive options as well (i.e., freeze-frame, audio plus graphics).

Although somewhat inconvenient, public systems could be used without investing in equipment and studios.

Pricing principles and rate structures for most telephone companies are generally similar. Rates for long distance service vary with usage (i.e., distance, duration) and time of day. Major factors and principles guiding rate setting are: rate averaging (i.e., all users pay the same price for same class of service), value of service, costs and usage level.

Charges for data services in general consist of access and transmission components. While access charges are fixed monthly amounts which are directly related to terminal transmission speed, transmission fees vary with volume and distance. In case of international data services, rates are based on national access charges and international network usage.

Charges for leased circuits, offered by telephone companies and CNCP are comparable.

As for space segment tolls, in early 1984 Telesat Canada received CRTC approval for rate increases for 14/12 GHz services (about 13 percent one time increase as well as future increments)*. This reflects special revenue requirements of Canada's satellite carrier (which in turn are caused by the risky nature of business, low growth in demand, unused capacity of satellites, and loss of potential revenue due to regulatory delays in subletting unused capacity to U.S. customers).

In 1981 typical charges for a video conference between Montreal and Toronto were as follows:

Front end charge of \$100.00 per studio plus \$43.00 per 15 minutes for transmission. These services were regarded as experimental, offered on "guard" video channels (which could be withdrawn from video conferencing at any time during the conference). In addition to rather high charges, there was lack of guaranteed channel time. On the other hand, as a sales incentive, Bell Canada offered to waive the front end charge for the first video conference ordered by a new customer. The experimental service did not recover its costs.

Telecom Canada's Conference 600 charges also include a front end charge plus half-hourly charges for transmission. These charges increase linearly with distance blocks (i.e., 0-300 miles: \$125.00, 301-600 miles: \$200.00; 601-900 miles: \$275.00, etc.) until the 1201-1500 miles block. From there until 1501-1800 miles, the charge is \$475.00. Beyond 1800 miles, transmission charge remains constant [96].

* As an illustration of Telesat rates, effective February 20, 1984, current monthly rate for full period, fully protected 1/2 Canada RF channel service is \$120,967.00, with unprotected, non-preemptible service set at \$84,677.00 and unprotected, preemptible service at \$76,613.00. Subsequent rate escalations, which were approved, consist of increases of 5.5% on July 1, 1985, and 1 January of each of the subsequent years in the test period [95].

As an illustration of a drop in transmission charges brought about by the satellite and associated technology developments, note the following interexchange rates for Toronto-Calgary (over three thousand kilometers -- over 1800 miles):

1982/83	\$2,200.00/hour
Summer 1983	\$1,200.00/hour (compressed, digitized video via Anik C satellite)
October 1983	\$1,000.00/hour (Conference 600 Tariff)

Teleglobe Canada's teleconferencing service between Canada and the U.K. and Canada and France is at present priced at \$2,400.00/hour (both ways -- 50% for Teleglobe). Prior to this tariff, without the benefit of cost-reducing technology, the tariff was approximately \$10,000.00/hour.

Tariff principles currently under consideration at Teleglobe Canada include the following:

- charges should be insensitive to distance,
- charges should consist of (i) an earth station access charge and (ii) a space segment (satellite channel) charge based on bandwidth and period of usage (volume/usage),
- the space segment part of overall charges should take into consideration the operational efficiencies of the satellite system.

What is the expected future price trend for satellite-based teleconferencing and other teleconferencing services? Considering that technology is still developing, in real dollars, tariffs could decrease in the future. In support of this view, the above tariff changes can be cited. Additionally, Teleglobe Canada data (1962-1982 data for telephone, telex, and telegraph) suggest that in constant dollars, the real price to customers of public telecommunication services has been declining.

Cost of point-to-multi-point ad-hoc video conferencing depends upon coverage (e.g., 1/2 Canada) and number of locations connected. The typical conference in Canada involves four locations with 100 participants each. The average cost of

teleconference -- \$30,000.00. Space segment costs, in spite of Telesat tariff increases, are expected to either drop in real dollars.

CHAPTER 5

TRENDS LEADING TO INCREASED USE OF TELECONFERENCING

5.1 Teleconferencing Trends

The objective of this chapter is to report information acquired from case studies and to examine the trend towards teleconferencing. Also, it is intended to note, from survey data, travel impacts (if any), including reduction in planned travel, avoidance of travel, and stimulation of travel (in terms of follow-up trips).

Teleconference activities are beginning to grow in Canada -- a trend which started about four or five years earlier in the United States. Teleconferencing services and facilities in Canada were described in Chapter 4 of this report. Here, the trends are to be examined in terms of installations, usage, traffic serviced by public facilities and revenue received.

Installations and the usage of audio teleconferencing exceed those of all other conferencing modes. A survey of teleconferencing in Ontario showed that about 72% of companies contacted use some form of teleconferencing and some three-quarters of users use speakerphones. About one quarter of users use private bridges. Slightly more than half go through Bell Canada Conference operator. Conference 2000 system and CNCP Broadband services are used by a small percentage of users, namely 15% and 6% respectively. Frequency of use is generally low -- an average of one to four times per week, except that CNCP Broadband (a more expensive facility) is used on a daily basis [97].

At present, in Canada, some use is made of telewriting, telecopying, electronic mail, videotex, computer-based conferencing, and video conferencing.

For instance, 16% of Ontario users of teleconferencing systems use computer conferencing or electronic mail. Similar estimates for slow-scan and video-conference systems are not available, but are believed to be relatively small in percentage terms [98,99,100].

Freeze frame and full motion video facilities have been installed in a limited number of private and public locations. These include: IBM, Royal Bank of Canada, several hospitals,* the Federal Government, the Government of Ontario, Bell Canada/Telecom Canada, Alberta Government Telecommunications and Teleglobe Canada. Another observation worth noting is that there is a trend toward the installation of dedicated four-wire networks on the premises of some large size organizations.

The usage of private freeze-frame and full motion video facilities is rather low. Video conferencing systems of the Ministry of Government Services (MSG), Ontario, has been used approximately to the extent of 8-10 hours/month. Promotional endeavors are likely to increase the usage of this system. IBM Canada's video system (including visual aids and freeze frame), that links Toronto and Montreal, is used approximately 3-5 times per week. Meetings conducted primarily by senior managers and marketing personnel are typically less than three hours in duration. Although studios can accommodate up to nine participants, meetings on the average involve 3 to 4 persons at each site. Royal Bank's video conference system (including supporting freeze frame capability), which links Toronto and Montreal, is used approximately 35 hours per month by middle management and executives.

Trends in the use of public teleconference services in Canada are slightly more pronounced. Telecommunications carrier revenues from teleconferencing, as a percentage of total income, is about one percent. According to Bell Canada, less than 3 percent of its teleconferencing revenues in Quebec and Ontario are derived from video conferencing. Total conference calls as a

* Please see Chapter 3 for the use of teleconference systems by hospitals. Likewise, tele-education cases are noted.

percentage of long distance calls within Canada are only a small fraction of one percent (about 1/20 of 1%) [101]. However, growth rate of teleconferencing calls, according to available information, has been approximately 30% per year in the early eighties. In comparative terms, in the U.S.A., between August 1980 and August 1981, the use of teleconferencing quadrupled [102].

Up to now, full motion/compressed video conferencing services of telecommunications carriers have not been used extensively in Canada. A number of reasons are involved. Modern video conference systems were implemented by Telecom Canada and Teleglobe Canada in late 1983. Rate structure for these services reflects technological advances noted earlier in this progress report. Prior to these developments, and to a certain extent, even with these advances, reasons for lack of high growth in the use of video conferencing include: high cost, availability at limited number of locations, and meagre marketing of video conferencing by the carriers. However, further technical improvements, cost reduction, increased availability across Canada, and enhanced cross-border and international linkages are likely to result in increased utilization.

According to 1980 data supplied by Telecom Canada, ranking of users of teleconferencing are: business, government (federal and provincial), universities, service industry (banks, etc.) and residential [103]. Conference call usage differed by categories of organization (i.e. employees). The government segment is notable in the large category (500 or more employees). For the medium-sized organization category (50-499 employees), heavy users of conference call systems are the manufacturing segment, followed by government. In this size range, the finance segment ranked third with quite high repeat usage. The service segment accounts for the largest number of calls and callers in the small business (1-49 employees) category. A number of classifications including Agriculture, Hotel/Motel, and Media/Recreation consistently generated the smallest number of calls across all business size categories. Market segments ranked somewhat differently across Canada in terms of calls and callers (e.g., for Bell Canada, a significant portion of calls generated by medium and large business customers in the manufacturing sector whereas outside of Bell

Canada, the government sector accounts for most calls) [103,104].

An indication of the usage pattern of video conferencing services can be obtained from Bell Canada's "trial period" of 1972-77. During these years, Bell Canada offered Conference TV service free of charge to corporate users and government agencies for video conferencing between Toronto, Montreal, Ottawa, and Quebec City. During the trial period, more than 6,000 conferees used the system for over 1,000 conferences. Over 60 non-Bell organizations used it during this period [105,106].

According to a survey of businesses in Ontario, the typical user firm of teleconferencing is large in size, with 500 to 1,000 employees in six to ten establishments. The majority of users are in the manufacturing business and are subsidiaries of larger corporations. Within user firms, teleconferencing is common to many departments and is used for a wide variety of communication purposes. Survey results indicate that user firms tend to be larger than non-user firms (in terms of employees). A majority of user companies plan to increase their teleconferencing in the near future [107].

Teleconferencing, as revealed by the Ontario survey, is used by virtually all administrative/finance departments (92%) and is also heavily used by marketing/sales groups (77%). Also, about 50% of all user firms indicate that their personnel, data processing, production and engineering research departments use teleconferencing. In terms of purposes, teleconferencing is heavily used (92%) for information exchange. Specifically a majority of users use it for planning (58%) and problem solving (66%). Other purposes reported by user firms, by percentage of users, include committee and staff meetings (42%), and inspection-supervision and training (21%) [108].

Ontario survey results suggest that about 25% of teleconference users are experiencing a reduction in their travel attributed to teleconferencing [109]. On the other hand, 2% of users see an increase in business travel as a result of teleconferencing [109]. The average decrease in business travel, for those who

indicated such a change (42% of respondents), amounts to about 20% of trips. Personnel belonging to user firms, as compared to non-user firms, have higher within-company travel experience. Such users are perhaps the ones who have cut down on the number of their business trips.

In the international communications area, despite sluggish economy, Teleglobe Canada's telephone traffic in 1982/83 increased 8.8% (vs. 24% in 1981/82). Three international teleconferencing trials have taken place as a part of Teleglobe's latest market development efforts (initiated in early 1984). As for other communication modes, the combined traffic volume for international telex and TWX service in 1982/83 dropped 5.9% owing to economic recession, a new method of calculating telex charges (to the nearest six-second interval instead of one minute), and encroachment from carriers operating into Canada from the U.S.A. [110].

International telegraph traffic, owing to the substitution of telephone and telex, has been declining on a world-wide basis for several years. In 1982/83, traffic declined by 18.1% as a result of substitution and also due to economic recession [110].

An area of considerable growth in international communications is that of private telecommunications services which serve message, voice, and data transmission needs of businesses such as multinational companies. In 1982/83, revenues of Teleglobe Canada from such services increased by 15.5%.

There is considerable information available in the U.S.A. and internationally about the current status of teleconferencing. A survey by the University of Wisconsin's Extension Program involved telephone interviews with 149 North American (U.S.A, Canada, Alaska, Hawaii) organizations currently using teleconferencing. Results show that 60% of the organizations became users in the 1977 to 1983 period as compared to only 40% during the 1962 to 1976 period. A large number of organizations currently have more than one type of system. It was observed that 40% had an audio-only system, 30% had audio with graphics, and about 15% each have slow-scan/freeze frame, two-way full motion video or one-way full motion video [111].

It was found that in terms of usage, audio only and two-way video systems were used most -- to the extent of slightly less than once a day on the average. In terms of utilization, audio-graphic systems were second followed by slow-scan/freeze frame and one-way full motion video.

In terms of travel impacts, it was noted by the respondents that their travel costs had decreased owing to teleconferencing.

5.2 User Attitudes

In this task, it was intended to acquire and examine available information on user attitudes collected through user surveys, case studies and demonstrations of teleconference systems. A large body of survey information is available on this topic. Surveys selected for examination are listed as Table 5.1.

General findings of the surveys are presented below. Special notable or unusual information that evolved from surveys is noted as well.

- (1) Communication needs that result in business travel include those that offer substitution potential. These can be classified as: information transmission and exchange, planning and implementation oriented tasks, and exploratory (problem solving) communications.
- (2) Teleconferencing in general could be used (effectively) for 40% to 60% of all business meetings. The percentage of international business meetings that fall in the substitutable category is not known.
- (3) Transactional (negotiations) type of tasks according to recent surveys could be carried out as well through teleconferencing. Such a finding, yet to be confirmed by further studies, would imply that 70% or even higher levels of all business meetings involving travel could potentially be substituted with telecommunications.
- (4) Non-business communications such as social services, education, medical information exchange and training, voting, and shopping (specific needs) are substitutable.
- (5) Travel could be stimulated by teleconferencing activities as a result of implementation oriented tasks, and negotiations evolving from teleconferencing.

Table 5.1
Selected Surveys of Users

<u>Survey/Study</u>	<u>Year of Survey/ Report</u>	<u>Sample/Method</u>
• Telecom Canada (TCTS) Business Teleconferencing Study [104]	1983	530 responses, areas served by TCTS (telephone interviews)
• Transportation Energy Management Program (TEMP), Ontario Survey of teleconferencing use (in Ontario) [97]	1983	307 companies in Ontario (telephone interviews)
• Government Telecommunications Agency (GTA) Survey of federal government managers/ professional employees [112]	1983	25 responses out of 100 persons contacted (mail questionnaire)
• University of Wisconsin (Extension) Survey of North American Teleconferencing users [111]	1983	149 organizations in U.S.A. and Canada (computer-assisted telephone interviews)
• Picturephone Meeting System (PMS) User Survey (A T & T) [113]	1983	69 completed responses (questionnaire study of users)
• Pilot (Trial) Survey of Organizations by Holbrook, sponsored by DOC [101]	1980/81	17 useful responses
• Bell Canada's Conference TV User Evaluation [105]	1979/80	22 responses (telephone interview)
• Bell Canada's Conference TV Demonstrations [106]	1979/80	82 responses (telephone interviews)

Table 5.1 (continued)

<u>Survey/Study</u>	<u>Year of Survey/ Report</u>	<u>Sample/Method</u>
• An evaluation of the Audio Teleconferencing Demonstration Project at the MTC (Ontario) [100]	1978-80, 1980	384 known users (questionnaire study)
• Study of Teleconferencing for Various Meeting Activities -- comparison of four systems including two Canadian systems -- Bell Canada's Video System and University of Quebec's Audio System [114]	1977	Questionnaire type of survey of users
• Bell Canada Survey of Travellers -- to investigate telecommunication capabilities required for travel replacement [4]	1975	9,619 usable questionnaires completed by travellers on business trips

- (6) In general, video conferencing is widely accepted for a variety of communication needs, but it is not regarded as essential for all substitutable communications. Most negative features of teleconferencing are associated with audio teleconferencing, although it is recognized to be inexpensive and generally effective for information exchange. The value of audio plus graphics is well recognized.
- (7) A large number of benefits of teleconferencing are perceived, including: effectiveness of meetings, improved productivity, faster decision making, easy access to additional resources persons, improved communications (among establishments), improved control, improved participation of employees, rapid follow-up meetings, reduction of travel costs and associated inconveniences, enhanced opportunities for education and training, efficient in terms of assessing and communicating information, improved marketing and profit potential of user firms, and enhanced image of a company as a business leader.
- (8) Many respondents felt uncomfortable with the idea of teleconferencing for the following reasons:
 - it might curtail freedom to travel to meetings and conferences,
 - a perceived loss of side benefits of regular face-to-face meetings,
 - a sense of the need for face-to-face contact,
 - a perception of lack of privacy or security.
- (9) The relationship between the use of teleconferencing and trips that are not made is uncertain. Most studies have taken the route of asking teleconferencing users (or even others) to speculate, attitudinally, on the level of substitution.
- (10) There is no major dissatisfaction with teleconferencing per se. However, the growth of teleconferencing depends on the recognition of human factors, senior executive support, technical performance, costs, availability at many locations, and others factors.

Highlights of findings of the above named surveys are listed in a tabular form as Appendix B.

5.3 Assessment of Trends Leading to Travel Impacts

Here, the intent was to investigate whether there is any evidence of travel substitution and/or stimulation. Also, it was expected that the data examined would provide a useful stepping stone for the study (in Chapter 6) of trade-offs between transportation and telecommunications on a disaggregated (mode/location/communication type) basis.

Availability of information was checked with transportation and communications type of organizations. Publications, data bases, and working documents of the following organizations were studied for data availability: Transport Canada, Statistics Canada, Ministry of Transportation and Communications (MTC) of Ontario, DOC, CRTC, Bell Canada, Telecom Canada and Canadian Teleconferencing Network Inc. Also, relevant data were extracted from international and U.S. sources.

It appears that direct observations (data) on current or past experience with substitution and/or stimulation are not available. As a part of users' surveys noted earlier, travel impact statements were acquired by various investigators. In addition to previously noted observations, numerous other cases (although mostly in the U.S.A.) have been reported.

Data acquired or selected factors that influence the travel-telecommunications interrelationship are summarized in Table 5.2. Sources of data are noted as well. A number of these data items were also required for an examination of other factors which have already been discussed (e.g., supply side factors).

From the information acquired as noted in Table 5.2 and findings of other assessments reported in previous chapters, the following types of analyses were carried out:

- Service cost and attributes of the various modes of teleconferencing.
- Comparison of the cost and service attributes of teleconferencing and travel modes (for face-to-face meetings).
- Study of business travel for the identification of target groups with high propensity to substitute specific modes of teleconferencing for travel.
- Study of corporate structure and budgets with respect to travel/teleconferencing.
- Growth of teleconferencing market.

Table 5.2

Data Availability for Travel-Telecommunications Interaction Study

<u>Information Item(s)</u>	<u>Source of Information</u>
Supply side data, including availability of services (local access, inter-exchange, percentage availability, conference rooms, security, portable equipment), tariffs, traffic and cost trends.	• Carriers/suppliers: Telecom Canada, Telesat, Teleglobe, Canadian Teleconference Network Inc. • Government agencies -- CRTC, DOC, MTC (Ontario). • General literature
Documentation of conference call records	• Telecom Canada (TCTS) Study of 1982 (confidential, essential data deleted).
Teleconference market projections	• Canadian information (developed by carriers) is mostly confidential U.S. projections of North American and U.S. markets.
Study of business travel in Canada - seasonability - distance - mode of travel - length of stay - accommodation - occupation of travellers - characteristics of travellers - age, sex, income, travel expenditures	• Canadian Travel Survey (CTS) data base (1979-80). CTS reports and circulars published by Statistics Canada and Transport Canada.
Factors influencing the individual's decision to travel - Nature of trip/reason for travel - Incentives to travel/cost of travel - Corporate structure and decision to travel	• Bell Canada Survey of 1975 • U.S. Surveys (Gold, Western, et al). • Surveys carried out in the U.K. and elsewhere.
Corporate structure, travel/telecommunications budgets and travel and telecommunications practices	• Limited data available from • DOC sponsored study of Holbrook (1980/81) • Telecom Canada sponsored study of Socioscope (1980) involving four brief cases.
Travel market growth forecasts and forecasts of cost of travel	• Transport Canada Forecasts (1983) • Transport Canada

5.3.1 Trends Leading to Travel Impacts

Findings of the above analyses are reported here and are used in Chapter 6 for the investigation of trade-offs. Growth in teleconference market is reported in Section 5.3.2.

- (1) Service attributes of teleconferencing in the eighties and early nineties are expected to meet all the requirements of business travellers for the substitutable category of business communication needs. These include the major factor groups of: convenient access, reasonable cost, quality of sound and picture resolution, availability of all equipment needed to support business communications (i.e., graphics, data, text, etc), security of information, and user friendly designs of hardware and software (including elimination of fatigue-causing factors).
- (2) There is a trend towards the offering of teleconferencing services which will combine the best features of the various conferencing methods (i.e., audio, video and graphics).
- (3) Comparison of the cost and service attributes of teleconferencing and travel modes is one of many essential ingredients of the travel (for face-to-face meetings) vs. telecommunications trade-offs. Experience in travel decision modelling points to the importance of service and cost differentials as important determinants in explaining choices made. While the options in this case are much more difficult to compare (considering that one option is travel leading to a face-to-face meeting and other activities associated with travel), the importance of relative service and economics cannot be negated.
- (4) As noted earlier in this report cost of travel and accommodation will continue to rise, probably at the rate of general inflation. In relative terms, telecommunications toll charges and equipment rental will rise at a lower rate. Such different growth rates would result in ever increasing cost differentials between travel and teleconferencing. Also, for a given level of cost difference, teleconference service of increasing sophistication, convenience, and capability would become a reality.
- (5) Considering that cost savings is one of the considerations, but not the only consideration in replacing a certain number of trips (for face-to-face meetings), it is essential that teleconferencing service must provide the

opportunity for savings in comparison to the alternative cost of travel. It is a natural tendency of businesses (under economic constraints) to view travel costs as a "bench mark" to assess the desirability of teleconferencing. The higher the cost differential, the higher the probability of substitution. What is not known at this time, however, is what threshold level of "generalized cost" (i.e., including out of pocket costs, cost of travel time, etc.) differential for a given communication need would result in a reasonably attractive level of substitution.

- (6) A number of observations are offered here on the identification of target groups with high propensity to substitute specific modes of teleconferencing for travel:
 - High frequency (e.g., every other week of the year) and/or more same day trips (savings of cost and time),
 - Air travel to distant destinations (cost and time savings) -- but such trips may involve several purposes and activities,
 - Longer trip durations for short or medium distances are less expensive per diem and also involve multiple meetings/activities,
 - Top and middle management groups (with highest propensity to travel) are the market with the highest potential for the replacement of travel with telecommunications,
 - Occupational categories with highest propensity to travel, namely, the sales occupation, finance, etc. are the groups which could also have the highest potential for substitution,
 - Based on the occupational and business travel needs characteristics, and perceived need for face-to-face contact, there are individual personality variables and non-business activities associated with business travel that would be important to this investigation.
- (7) Study of corporate structure and budgets with respect to travel/teleconferencing is essential for understanding the substitution and stimulation phenomenon. A number of observations are highlighted here:
 - Motivation and innovation at the top management level is important for the establishment of teleconferencing as a serious means of communication,
 - Individual's travel decisions (vis-a-vis telecommunications) are influenced by organizational factors. Thus, decision to use teleconferencing rather

than travel (for other than top executives) may not be solely influenced by the individual's attitudes since organizational policies and budgets have an important effect. In case of budget cuts, it is likely that both travel and telecommunications budgets are affected. What would enhance the communications of the firm (and the substitution process) is the activity of trade-off between travel and telecommunications. That is, in the event of budget cuts, teleconferencing could be encouraged for continued communications.

- (8) Limited information obtained from a survey of businesses indicates that:
- Travel as a percentage of sales ranged from 0.01% for the largest company to 5.5% for the smallest.
 - Long distance expenses as a % of sales ranged from 0.025% (for the smallest company) to 2.0% (for the largest company).
 - Teleconferencing as a percentage of long distance ranged from 0 to 10%.
- (9) On the basis of limited information, researchers have identified a correlation between the size of the organization (i.e., number of employees) and the percentage of total sales or total operating budget used for travel costs and for long distance communications costs. It appears that there is an inverse relationship between the percentage of budget spent on travel (T), and the number of employees in the organization (N).

$$T = \frac{X}{N^p}$$

A similar relationship holds for the percentage of total budget spent on long distance telephone calls (C) and the number of employees:

$$C = \frac{Y}{N^q}$$

The ratio of T/C for businesses is found to be

$$\frac{X/Y}{N^{(p-q)}} = \frac{50}{\sqrt{N}}$$

A limited study of the Government Telecommunications Agency attempted to find parameters, N, T & C, for various federal government departments in order to determine the curve for the government. Results were not conclusive. However, it was found that except departments with special programs (e.g., CIDA, Dept. of Indian Affairs and Northern Development, most government departments could follow a pattern similar to the one implied by the above equation).

5.3.2 Teleconference Market Growth

Growth of teleconference market in Canada is expected to show a time lag as compared to the U.S.A. For the U.S.A., numerous projections have been reported. These vary significantly. A most reasonable estimate shows teleconferencing revenues to grow by a multiple of 6.3 (in real dollars) in the 1985-90 period -- from \$1.12 billion in 1985 to \$7.04 billion in 1990 in the constant dollar of 1982. Total teleconferencing revenue as a percent of total communication revenues was set at 1% in 1985 and it is expected to grow to 5% by 1990.

As for Canada, current teleconferencing revenues are about 1% of total telecommunication revenues. Also, in 1982 Canadian total operating revenues of telecommunications carriers were \$8.39 billion which is about one-tenth of the U.S. telecommunications revenues. As an approximation, teleconferencing growth in Canada is likely to be similar to that of the U.S.A. with a few years of time lag.

According to Bell Canada, the teleconferencing market in Canada is expected to increase tenfold by 1990 (from 1982/83). Most growth is expected to occur in audio plus electronic graphics and freeze-frame video systems. Also, according to projections, by 1990, 60% of all Canadian businesses will use teleconferencing and 90% of the educational community will offer teleducation courses. Other services, such as the public video conferencing service now offered by Telecom Canada, will become available in an extensive manner.

Chapter 6

TRADE-OFFS BETWEEN TRANSPORTATION AND TELECOMMUNICATIONS

6.1 Introduction

This chapter covers the essential facets of trade-offs between transportation and telecommunications. Included are a description of the overall benefits of teleconferencing, and an analysis of cost and service differentials. As argued in the following chapter, it is believed by the author that only air, and train service (in short haul corridors) could be affected by teleconferencing. However, cost and service differential analyses have been carried out only for air travel vs. teleconferencing services. In the absence of fare and service characteristics of future train services, comparable analyses could not be carried out for passenger train travel vs. teleconferencing. Findings of the air transportation case are assumed to apply to passenger rail. As for areas of impact studies, short haul corridors, long haul routes and North-South travel in Canada are examined. Trans-border and international travel are discussed as well.

6.2 Modal Attributes

In the study of trade-offs, it is important to know those factors that are considered by the consumers for assessing their perceived desirability of transportation vs. teleconferencing. The same set of factors, although under different conditions (e.g. communication tasks) are likely considered by consumers in generating new travel (i.e. the stimulation of travel). A list of selected attributes is provided in Table 6.1.

Cost

In the case of travel, user costs include door-to-door cost of transportation, accomodation and meal costs (if applicable), and time costs, although applicable only to out-of-conference working hours. Teleconferencing costs include: cost of service, including costs of access and egress to the terminal. For private studios on customer premises, charges for local access loops are to be included

Table 6.1
Selected Attributes of Transportation and Telecommunications
(Level of Service Variables)

	Transportation	Telecommunications (Teleconferencing)
Cost to User	Door-to-door travel cost, accommodation and meals costs	Price of service including cost of access/egress to studios
Time	Total door-to-door travel time, layover time during normal working hours, and meeting time.*	Travel time to and from public studio, waiting time (if applicable), and conference time.*
Service Availability	Availability of service on demand (probability of getting service at desired time, frequency, convenient departure and arrival times)	Availability of service on demand (probability of getting at desired time), availability of required features of service (e.g. graphics capability)
Comfort and Convenience	Comfort -- seating comfort and availability; access/egress comfort Service reliability -- on-time arrival Changing vehicle (transfer)	Studio design for user physical and psychological comfort Service reliability -- reliability of equipment, quality and capability of service

* Time spent in a teleconference meeting is generally less than face-to-face meeting.

Source: Khan (Reference 116)

in teleconferencing charges.

Cost of air travel by Canadian trunk carriers has been increasing, since 1971, at a rate which is slightly below the level of general inflation. Regional carriers are an exception (Figure 6.1). The rate of increase in air transportation cannot be shown on a route basis owing to the difficulty of allocating airline costs reliably on a route basis.

Future change in air transportation costs are expected to reflect the influences of a large number of factors including stable fuel prices and the recently announced deregulation policies. Favourable fuel prices are expected to lessen cost pressure and reduce at least part of the uncertainty in respect of future air fares. Other influences, however remain uncertain. The effects of deregulation policy in respect of air transportation, especially in terms of the future structure of the various classes of fares, are difficult to predict. Factors that will logically influence the fare structure include: competitive pressures, fuel price, taxation, the future fleet mix, and the financial status of the airlines.

A comparison of Canadian and U.S. regular economy fares in 1983 suggests that Canadian fares are in between those offered by U.S. major carriers and U.S. low cost carriers. Also, Canadian lowest fares available in 1983 were slightly above those offered in the U.S.A. by low cost carriers.

Naturally, in response to the regulatory reforms, the aviation industry will be under pressure to create structural changes in the industry's cost structure. In the U.S.A., the yield per revenue passenger mile (RPM) in constant dollars shows a slight decline (Figure 6.2). These observations, however, should be viewed with much caution since the influence of the U.S. deregulation policy cannot be separated from the impacts of the air traffic controllers strike, rapid fuel price increases in 1979 and the economic recession. On the basis of these observations, it is assumed in this research that air fares in constant dollar terms will drop by about 10% by the end of the decade. Other costs associated with travel, namely accomodation and meal charges are assumed to grow at the level of general inflation.

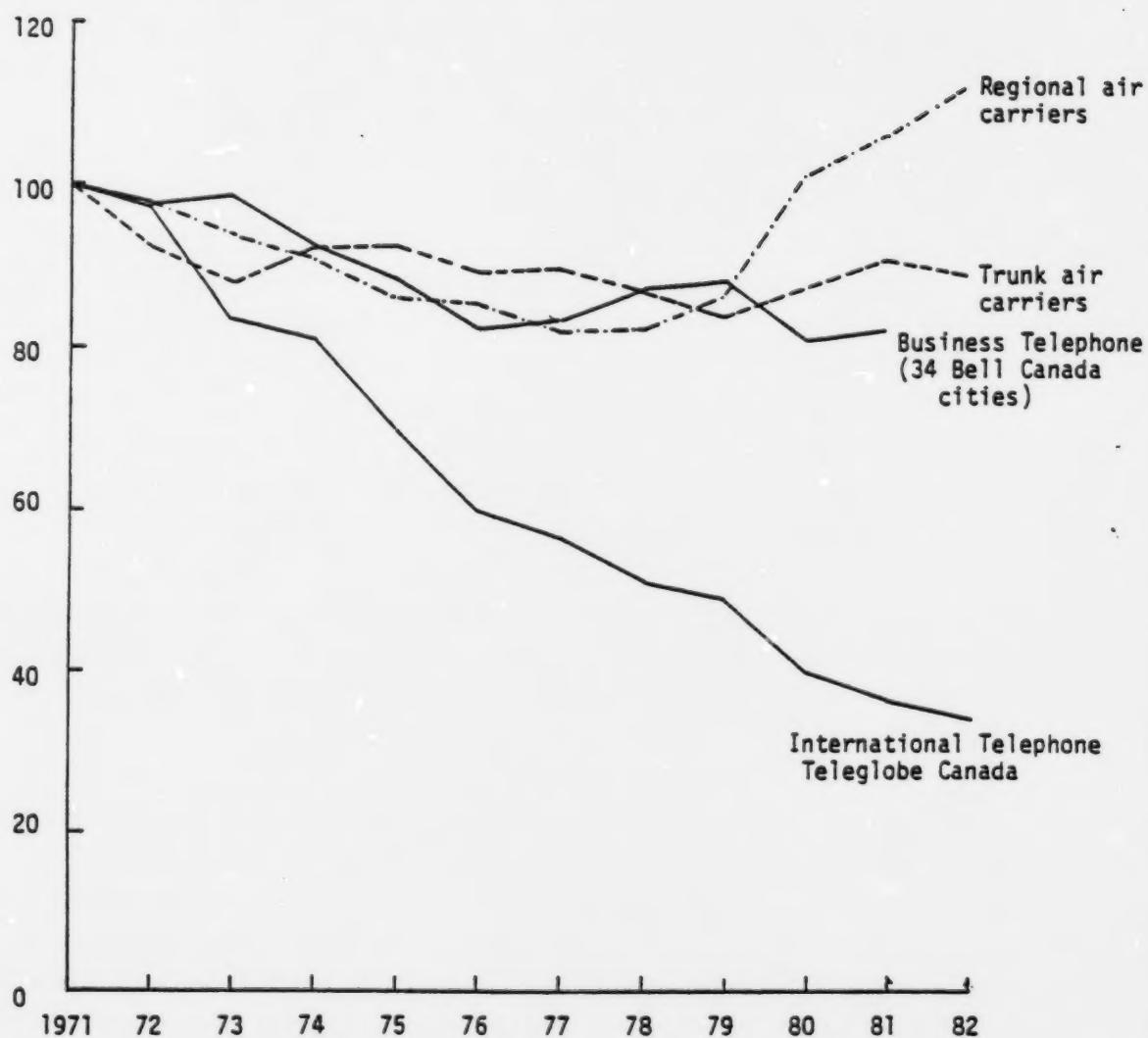
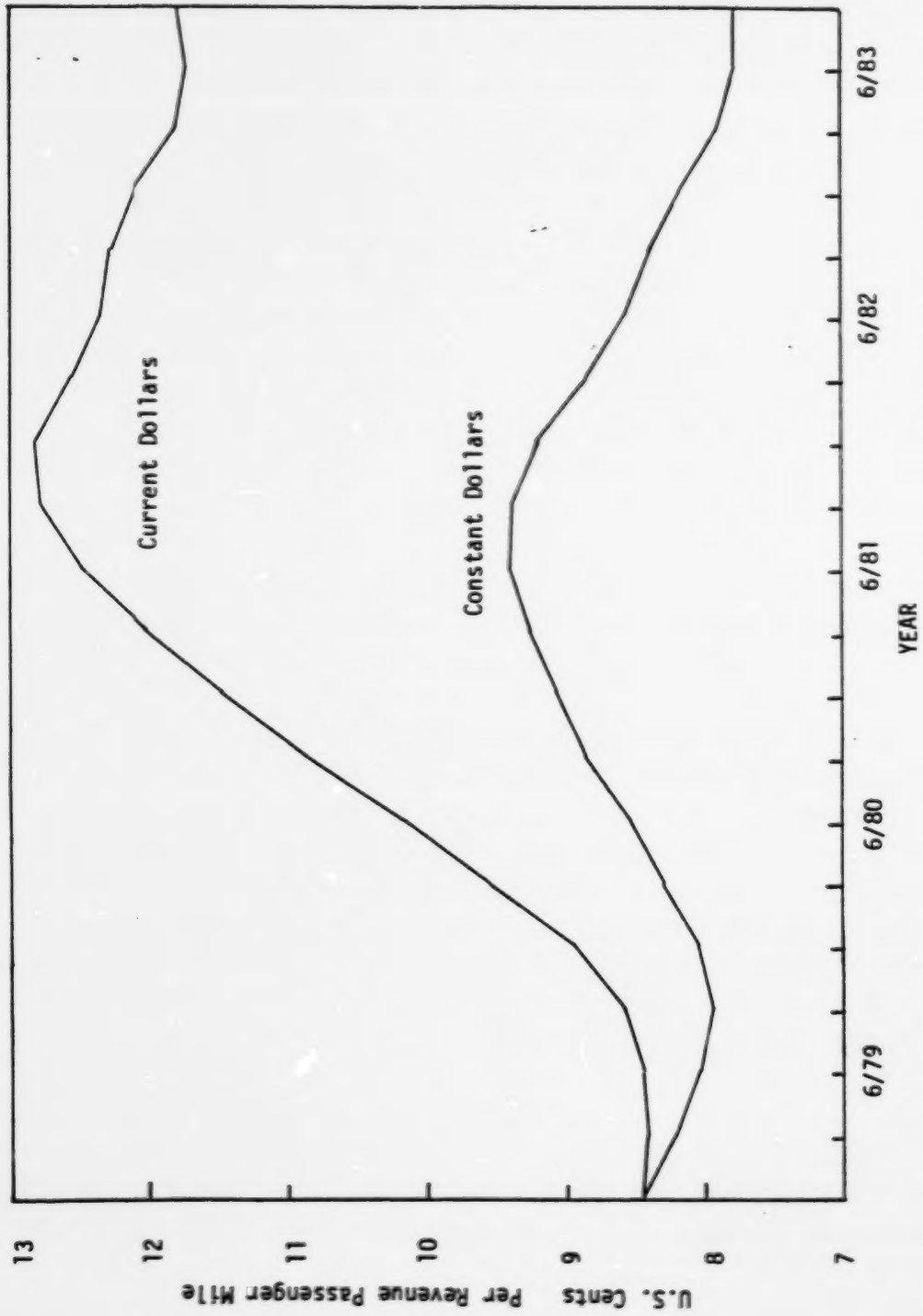


Figure 6.1: Changes in Unit Revenue of Air Carriers and Price of Telecommunication Services
(In Constant Dollars, 1971=100)

Figure 6.2: Yield Per Revenue Passenger Mile (Current & Constant \$)



Source: CAB, 1984

While analyses of passenger rail vs. teleconferencing are not attempted here, a general observation on rail fare changes in the future would be helpful for inferences to be drawn on the level of replaced travel. It is assumed that rail service will be improved in short haul corridors. Also, it is assumed that the price of rail travel, in spite of subsidy requirements, will not grow at a rate higher than the rate of inflation.

The influence of technology in reducing telecommunications costs has been analyzed in previous chapters. Figure 6.1 shows the changes in real cost of business telephone as well as international telephone services. In the case of business telephone charges, the drop in the price has not been as dramatic as that of international service owing to the distance factor and possibly the practice of cross-subsidizing urban services through overall revenues of the carriers. As noted earlier in this report, increased competition in the U.S.A. resulted in reduced intercity business rates.

Changes in long distance telephone charges, in relative terms, have been more pronounced in the case of the long haul link (i.e. Montreal-Vancouver) versus a short haul link (i.e. Montreal-Ottawa). See Figure 6.3.

Cost of teleconferencing is expected to drop in the future. Transmission costs, which form about 50% of overall end-to-end costs are likely to be about one-third of their current level (in constant dollars) by the end of the decade. This would result in teleconferencing charges for 1990 to be two-thirds of their current level. It is also projected that in the 1990-1995 period, other cost reductions will materialize owing to increased traffic and shared use of local and space segment components. This would result in teleconferencing charges in 1995 to be 50% of the current price (in real dollars). From 1995 to 2000, no further cost reductions are projected.

Time

Among the three components of time related to in-person meetings (as shown in Table 6.1) travel time and layover (business hours) time are generally more pronounced. Estimates of in-person meeting duration, in terms of the average,

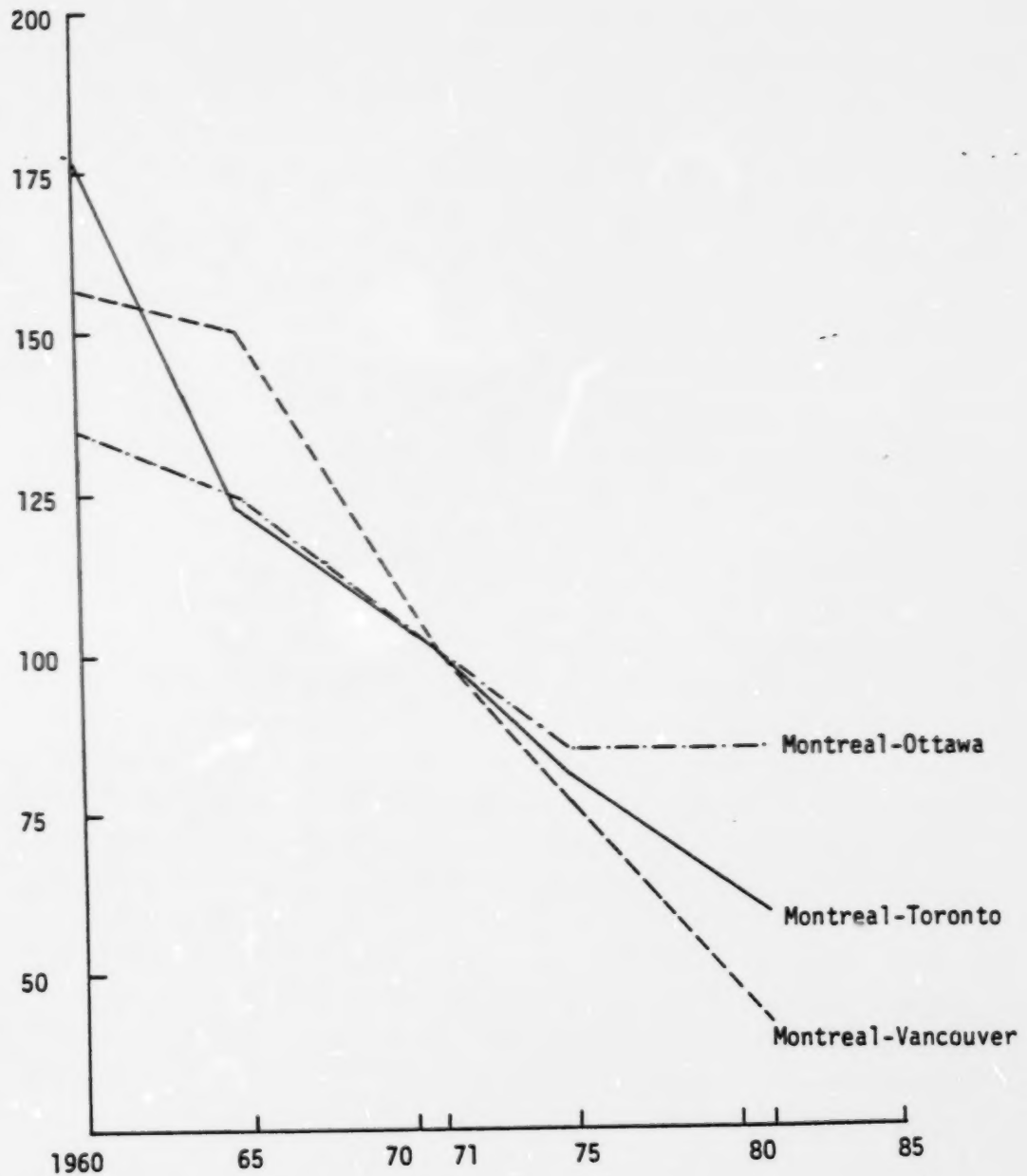


Figure 6.3: Change in Long Distance Telephone Charges
(In Constant Dollars, 1971=100)

have been stated to vary from 2 to 4 hours. According to a sample of over one thousand business meetings in the U.S.A., the average duration was 3.8 hours and the median was 3 hours. Figure 6.4 shows the meeting duration profile. Depending upon the travel distance, a meeting of four hours duration could easily involve a two-day absence from the office.

Most managers spend a substantial portion of their time in travel to meetings (up to 8% according to an estimate shown in Figure 6.5. Another notable factor is the amount of time spent by managers in scheduled meetings (up to 50% of a manager's time). Considering that teleconferences are better organized and take less time per meeting, a manager need not spend as much time in teleconferencing as would be necessary for face-to-face in-person meetings.

There have been conflicting reports about the inconvenience of using public studios by business managers. Most past studies indicated that potential users are sensitive to the time and inconvenience (e.g. intra-urban travel) of using public studios which are physically separate from their offices. However, a recent survey by Teleglobe Canada indicates that a centrally located accessible studio would not be a constraint to the use of teleconferencing (out of 93 respondents, 70% would use a conveniently located studio; 30% would use their own on premises room, if available) [12].

The option of developing private studios for many companies, owing to up-front investment in private facilities, is not attractive. Public studios are also required in many instances because of the scarcity of local video wideband networks serving customer premises and the lack of widely accepted international teleconferencing standards.

Service Availability

While transportation services are generally available for trips planned much in advance of meeting dates, there are at times difficulties in securing convenient travel arrangements on short notice. Arranging a teleconference

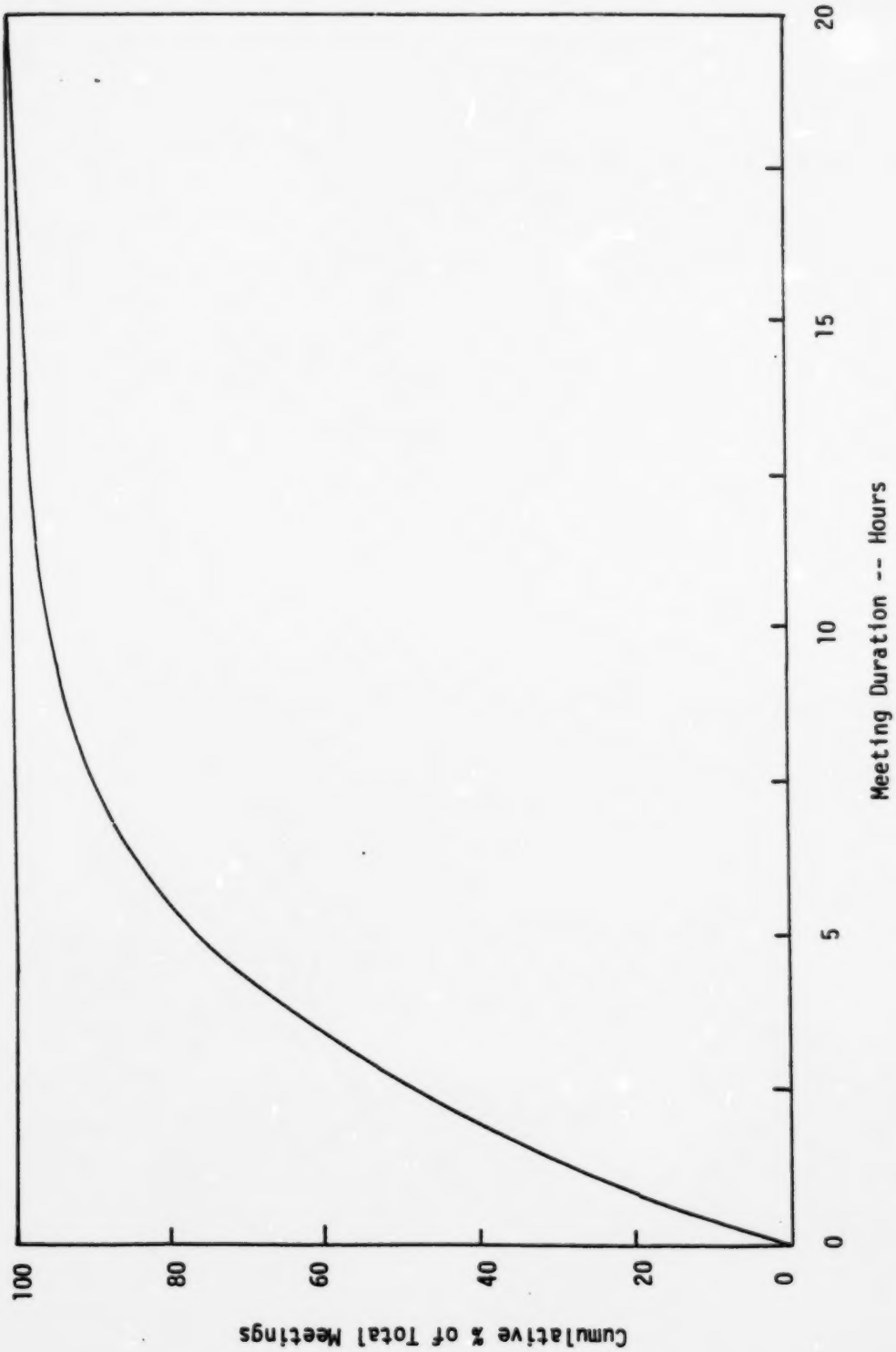


Figure 6.4: Meeting Duration Profile
(Sample Size: 1,112 Meetings)
Source: Satellite Business Systems, U.S.A.
(Harkness, R.C. & P.G. Burke)

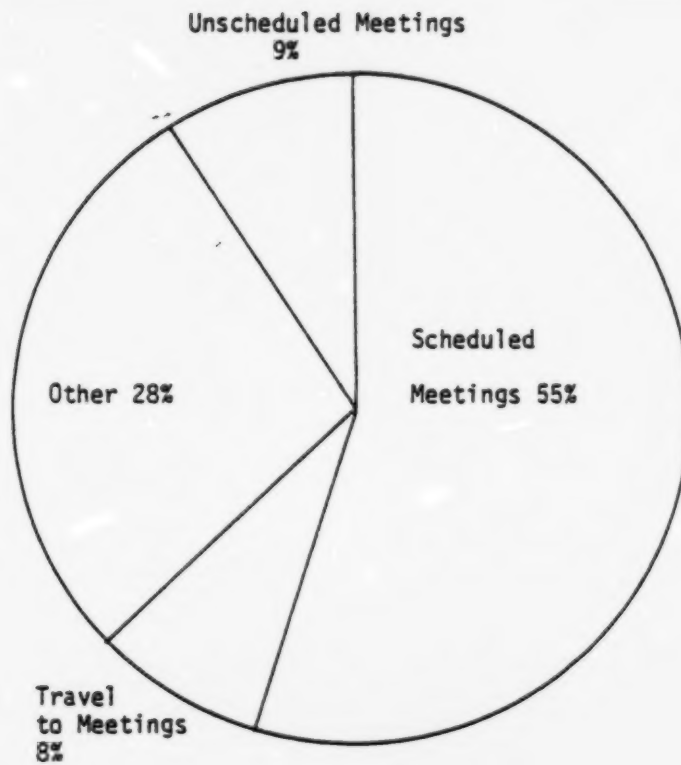


Figure 6.5: Typical Manager's Time

Source: TEMP

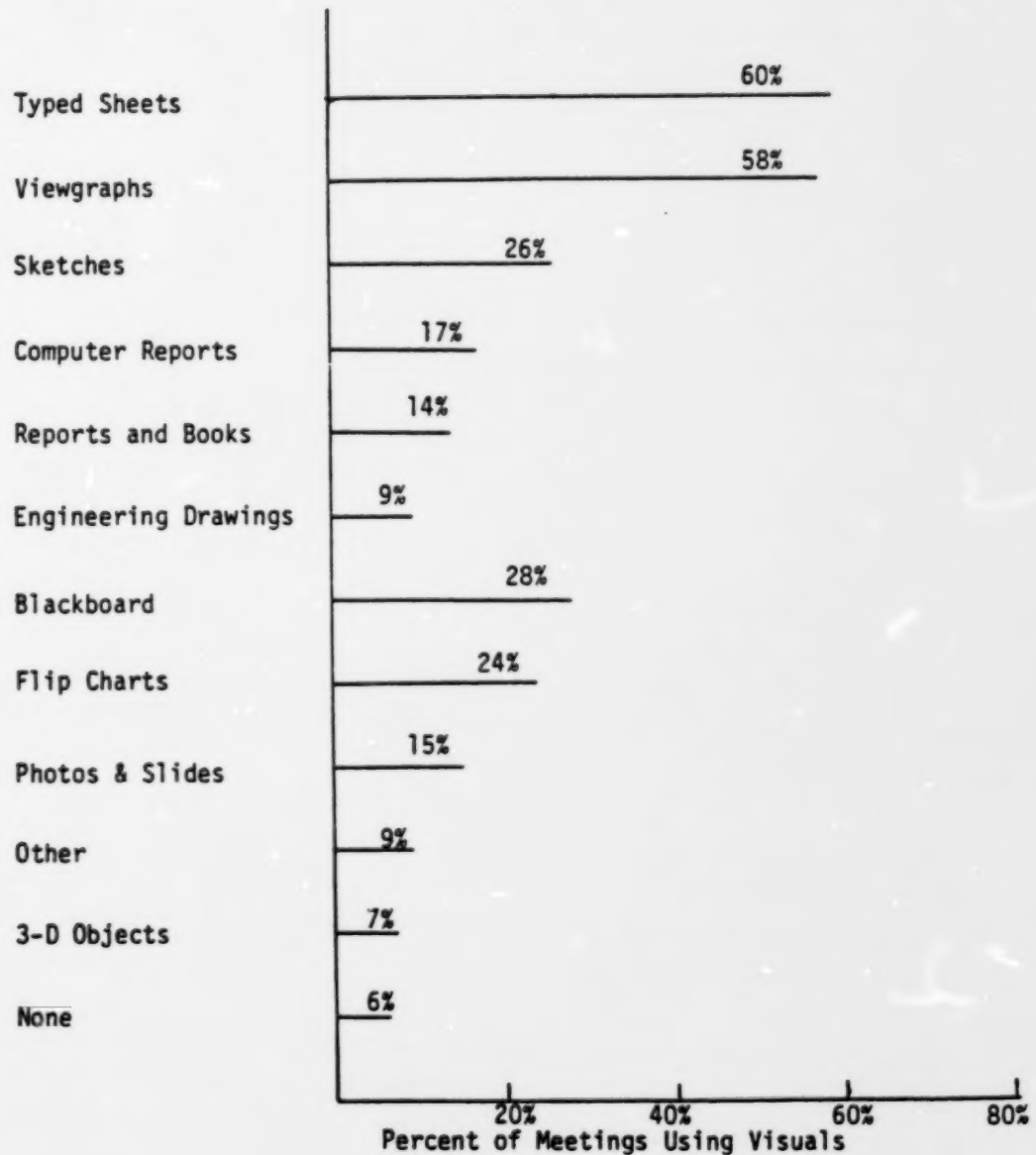


Figure 6.6: Graphics -- Visuals Used During Meetings
(Sample: 10% Meetings, 1979)
(Source: Harkness, R.C. and P.G. Burke)

takes relatively much less time. However, the availability of teleconferencing facilities could also be a problem. According to Teleglobe Canada's studies, 40% of all business meetings require the exchange of documents and 65% of such meetings require that information be presented/conveyed visually [23]. Results of another survey, in terms of conference support requirements are illustrated in Figure 6.6. Considering that over 70% of all business meetings are intra-corporate, there appears to be a logical interest on the part of multi-location and multi-national firms to be attracted to teleconferencing.

Comfort and Convenience

Comfort, convenience and reliability attributes of teleconference systems are improving since technical and human factors have been targets of planning and design investigations. Also human factors are becoming favourable to teleconferencing owing to wide-spread familiarity on the part of technical and managerial personnel with computers and communication means in general. On the other hand, the level of service of transportation is, at least in some instances, deteriorating owing to increasing congestion at busy airports and on access/egress facilities.

6.2 Benefits of Teleconferencing

The benefits of teleconferencing are becoming known. These, although described in one form or another in other sections of this report, are summarized below.

1. Productivity improvements occur through reduced travel time and possibly efficient communication. As noted above in Section 6.2, in a large number of cases, travel that requires two days is undertaken for meetings that last no more than a few hours.
2. Shorter and generally better organized meetings are arranged at short notice vis-a-vis face-to-face in-person meetings. It has been acknowledged by numerous survey respondents that a major value of teleconferencing

arises from its inherent property of allowing communication on occasions when an in-person meeting is infeasible (e.g. urgent decision required).

3. For a variety of applications, teleconferencing is a reasonable simulator of face-to-face in-person meetings.
4. It allows faster decision making and easy access to additional resource persons. This is indeed an innovative application of teleconferencing. For instance, one or two persons may travel to an in-person meeting, during which a one or two-hour videoconference is planned to increase participation from travellers' base office -- perhaps experts for further consultations or superiors to ratify decision reached.
5. Teleconference systems can be used for improved planning for a business in-person meeting -- thus enabling users to obtain better value from those meetings which involve costly travel. For instance, teleconferencing could be used to plan agendas for in-person meetings and to control the implementation of decisions reached during in-person meetings.
6. Rapid follow-up meetings can take place for the implementation of decisions.
7. The quality and quantity of communications among branch offices and between branch offices and the headquarters can be enhanced.
8. It allows improved control by the management in central (headquarters) locations over branch operations.
9. It serves to increase participation of employees in dispersed multi-location sites -- which is likely to enhance their commitment to the organization.
10. In appropriate circumstances and conditions, it permits reduction of travel costs and the associated inconveniences. According to Teleglobe Canada survey results (involving 93 organizations in Ontario and Quebec), the travel savings benefit of teleconferencing was stated by 97% of respondents

to be the single most important criterion in the minds of potential users [121]. In relative terms, 82% of respondents stated teleconferencing to be a means to save travelling time and thereby enhance productivity.

11. It offers additional opportunities for professional education and training.
12. It is an efficient mechanism for assessing and communicating information.
13. It offers the opportunity to integrate teleconferencing with other automated office technologies.
14. It has the potential to enable planned decentralization of organizations and land use developments. A by-product of such developments is the avoidance of congested travel conditions and high office rents.
15. Energy savings can be achieved.
16. Communications with sales persons could be improved and there is potential for improved profits through new marketing opportunities.
17. User companies could enhance their image as innovators.
18. It enables an extension of government services on a cost-effective basis.

A number of disbenefits of teleconferencing should be noted as well.

1. There is a lack of personal interaction which many regard as essential to improve morale, working relationships, etc.
2. There is the lack of recreational or social opportunities at destination which are a by-product of travel.

3. A number of users express a feeling of frustration with teleconferencing and, depending upon the quality of the system, the level of exchange for some tasks has been perceived to be limited.

6.3 Service and Cost Differentials

Among the list of factors that defined benefits of teleconferencing, cost and service (including time) are the most important attributes. Logically, service and cost differentials are the most important determinants of travel substitution decisions.

Experience of teleconference service suppliers suggests that economic benefits are the single most important criterion for consumer acceptance of teleconferencing followed by intangible benefits. Another observation that can be drawn from carrier studies is that the international business community wishes to have economical service which can provide features that stimulate face-to-face meetings. This of course implies a videoconference system.

In this section, cost and service differential between air travel and teleconferencing are studied for selected travel contexts and routes.

6.3.1 Short Haul Corridors (Domestic and Transborder)

Short haul corridors, namely Quebec-Windsor and Edmonton-Calgary, feature good quality air services. In most instances, distances are short enough so that same-day return is feasible. Transborder short haul routes, in some instances also offer same-day return in air services (e.g. Ottawa-New York). Many transborder links, however, fit into the Toronto-Calgary type of long haul air link where over-night stay is required.

By way of an illustration of cost and service differential, costs of air travel and teleconferencing are compared for 1984/85, 1990, 1995 and year 2000 (Figure 6.7). Cost projections were made according to observations presented in Section 6.1. Cost difference (which includes time costs, costs of

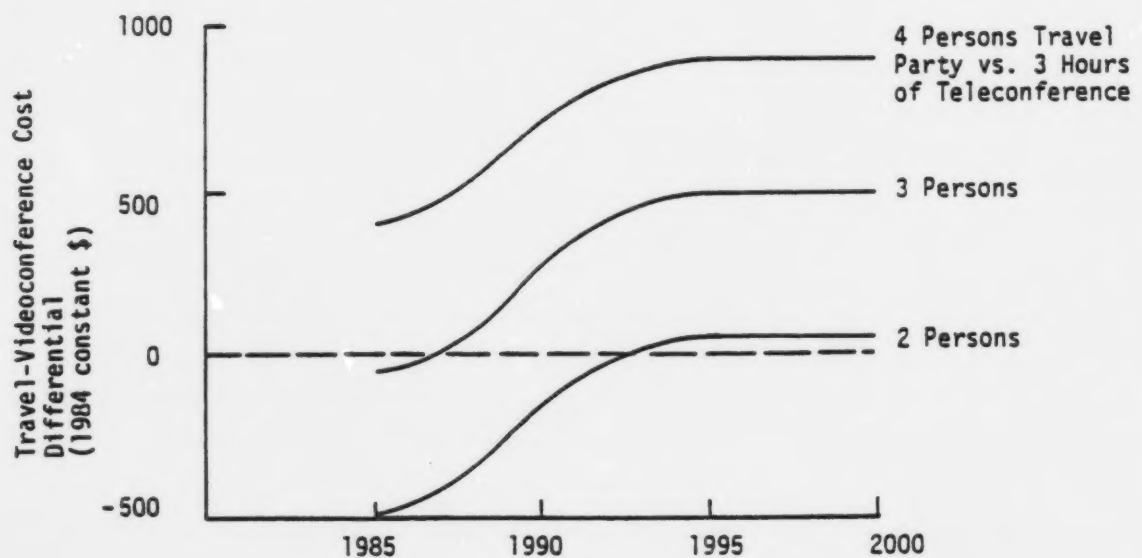
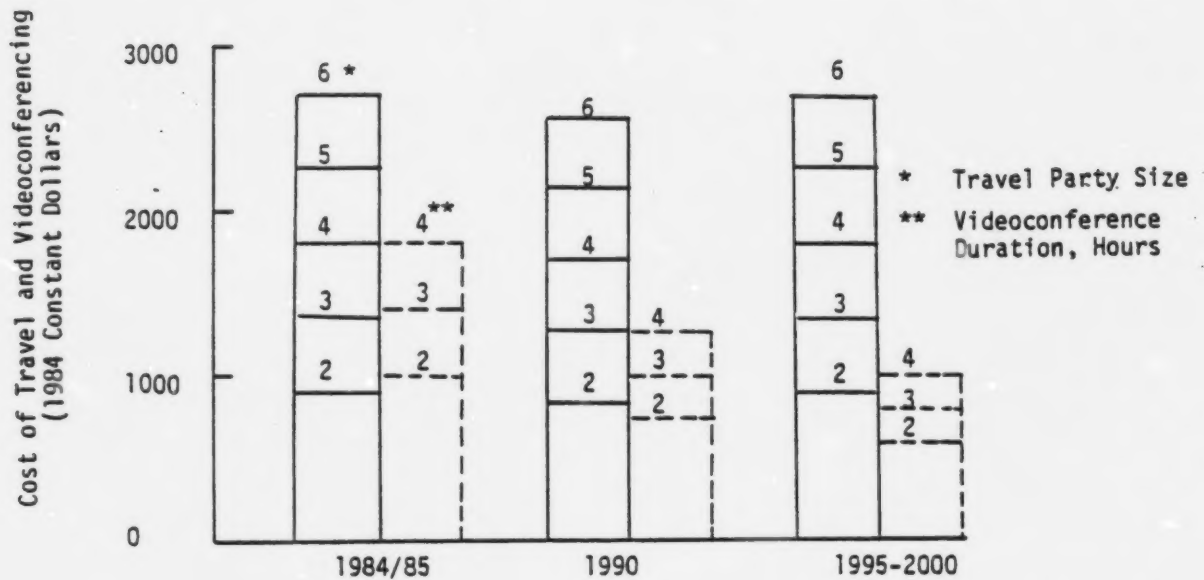


Figure 6.7: Travel vs. Videoconference Cost Differential,
Toronto - Montreal

accommodation and meals) between travel and teleconferencing for future years are noted. As expected, the cost difference between the options of travel and teleconferencing increases over time owing to a relative drop in teleconferencing costs.

Results shown indicate that at the 1984/85 level, teleconferencing is not feasible in terms of dollar savings. However, the desirability of teleconferencing in economic terms improves over time.

6.3.2 Long Haul (Domestic and International Routes)

Toronto-Calgary and Toronto-London (England) are used as illustrations. (See Figures 6.8 and 6.9). Cost savings attributable to teleconferencing increase over time. Also, for a given year, cost savings increase due to an increase in the size of the travel party. At the current (i.e. 1984/85) price levels, teleconferencing costs more than travel in case of a 3 hour long teleconference vs. a two-person travel party.

For the Toronto-London (England) link, according to the estimates developed here, even in year 1990, it will be less costly for a two-person travel party to travel than to teleconference. However, as the size of the travel party increases, cost savings become much more pronounced for long haul routes than for short haul corridors.

6.3.3 North-South Travel in Canada

Cost of North-South travel in Canada is very high. Scheduled air service costs are high owing to long distances and low density traffic markets. In those instances where charter air services are the only means of travel, costs are even higher. While detailed estimates of business vs. other travel purposes are not available, it is likely that the overwhelming majority of travel is almost certainly for business purposes, including government/institutional travel.

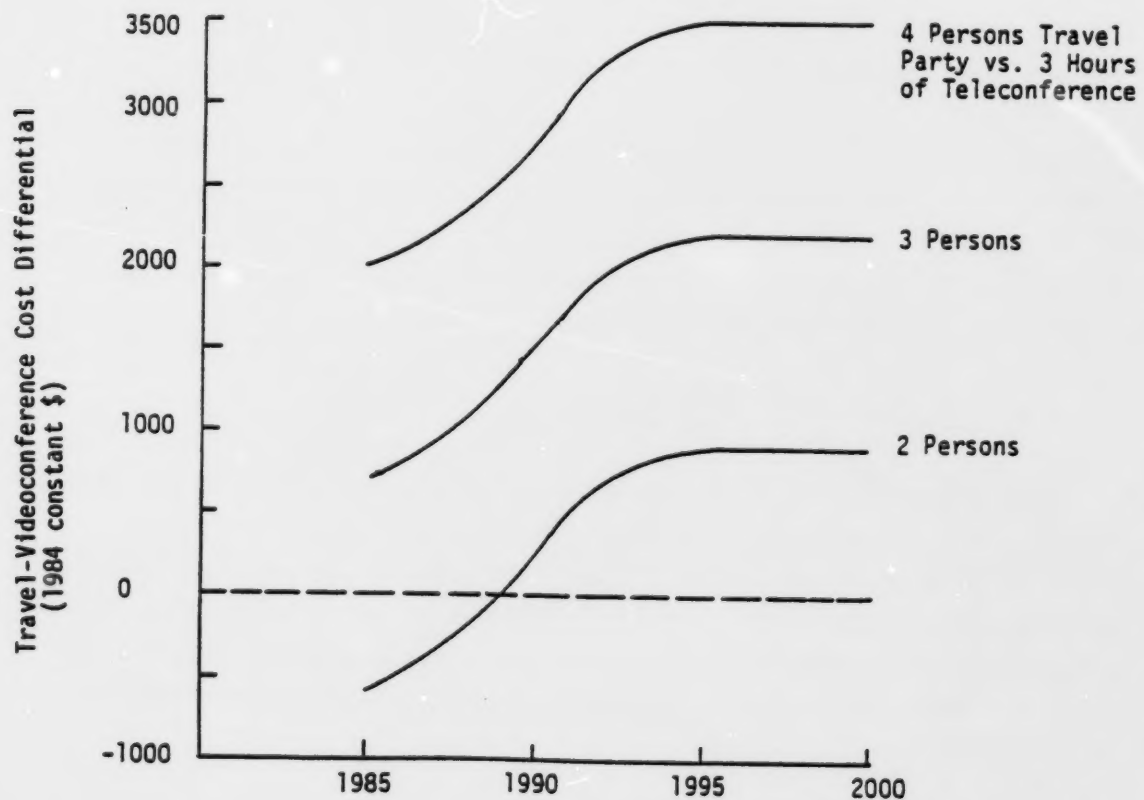
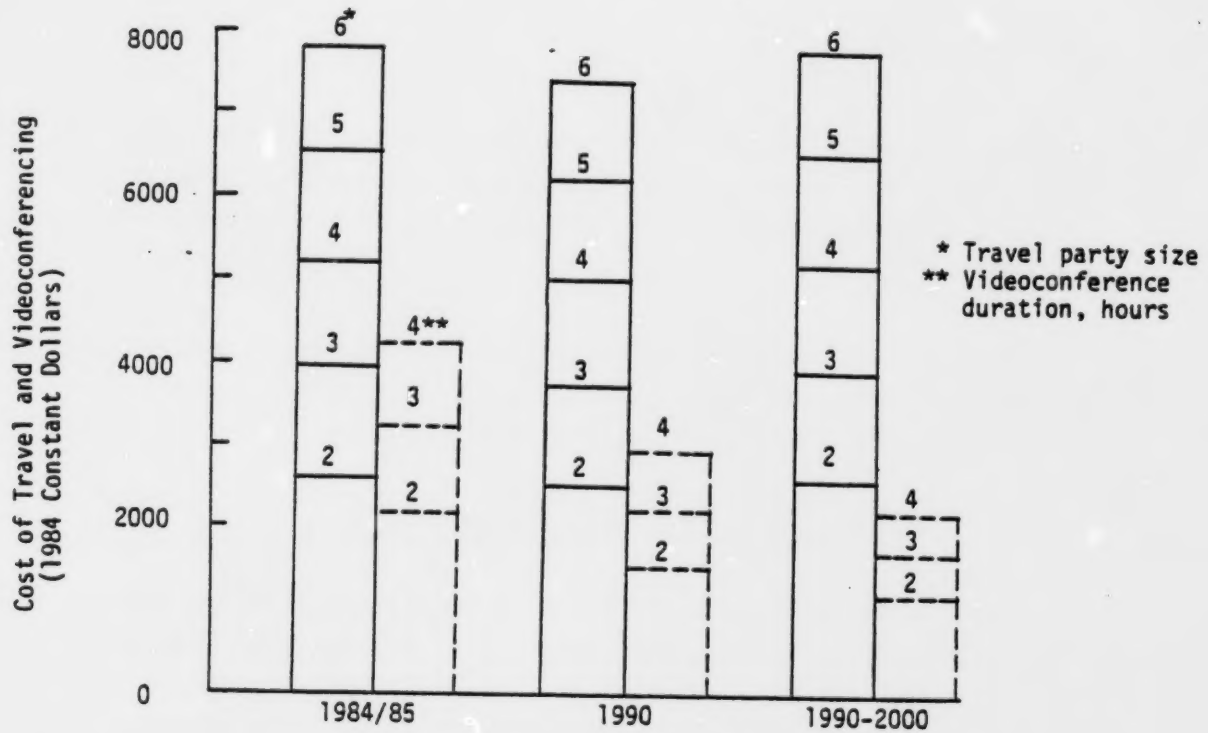


Figure 6.8: Travel vs. Videoconference Cost Differential, Toronto - Calgary

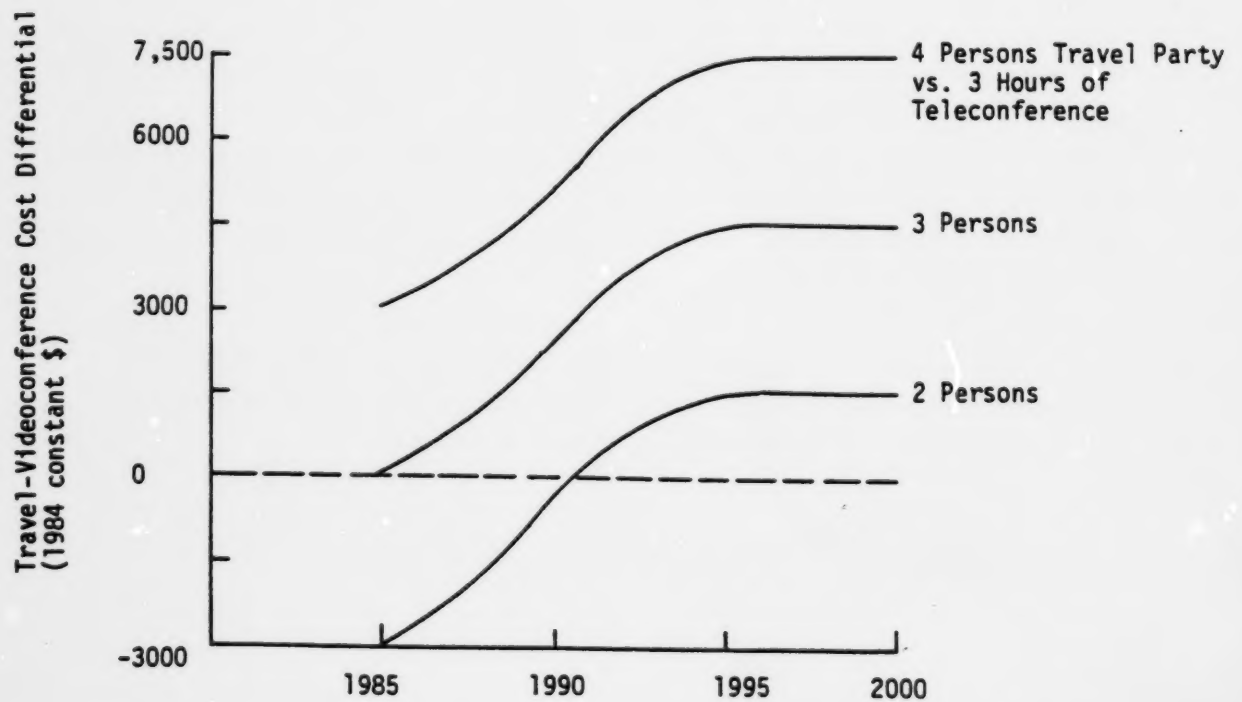
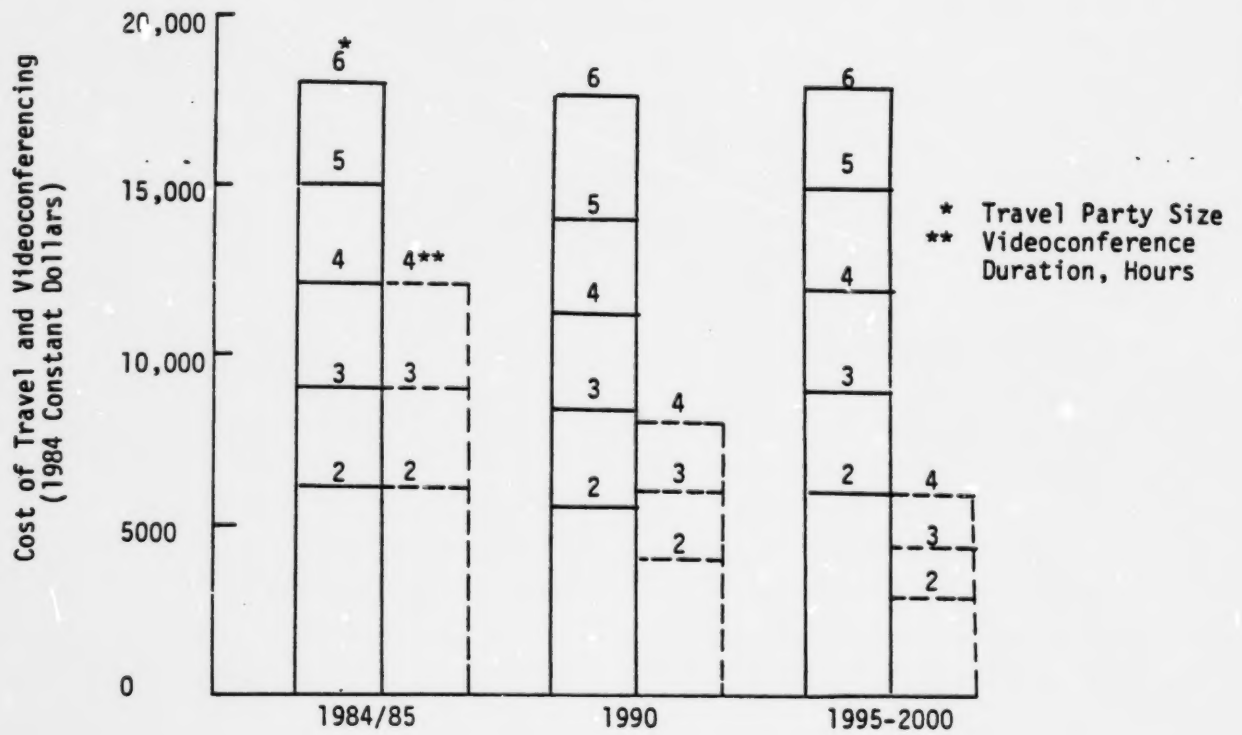


Figure 6.9: Travel vs. Videoconference Cost Differential, Toronto - London (England)

The substitution of teleconference for travel would likely yield substantial monetary savings. Other factors such as inconveniences associated with travel, would also provide further incentives to the use of teleconferencing for a part of communication needs.

6.3.4 Comparative Assessment

As illustrated in Figures 6.7, 6.8 and 6.9, cost differential between transportation and teleconferencing is not uniform in the travel contexts examined. In addition to the distance and market factors that influence transportation services and charges, satellite transmission enables the transmission portion of teleconference costs to be distance-insensitive. Such an influence is quite clear from an examination of Toronto-Montreal, Toronto-Calgary and Toronto-London cases (Figure 6.10).

In theory, relative cost and time considerations suggest that long haul and North-South travel should be substitutable to a higher degree than short-haul travel. There are, however, other considerations and influences. For instance, for those who make frequent short haul trips to the same destination, same-day return or even overnight stay are inconvenient. Long haul air links (domestic/international) require longer travel times and layover times for a meeting of relatively shorter duration -- thus favouring substitution. On the other hand, international travel has associated attractions -- especially for the infrequent traveller.

In the following chapter, an attempt is made to balance a number of these considerations in order to draw inferences on the relative extent of travel replacement in representative travel contexts.

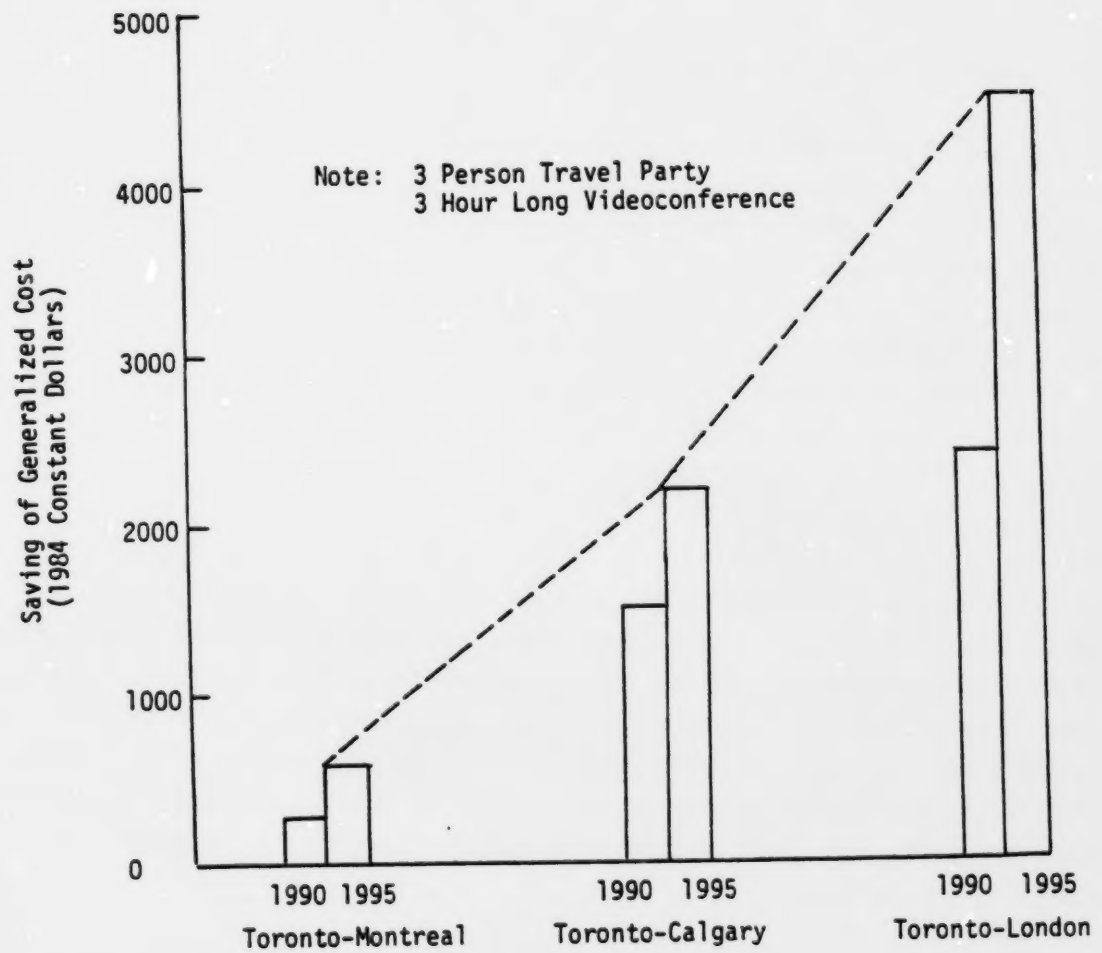


Figure 6.10: The Effects of Distance and Cost Change Over Time on Videoconferencing vs. Travel Cost Differential

Chapter 7

NATURE AND LEVEL OF TRAVEL IMPACTS

7.1 Substitution and Stimulation

This chapter presents projections of the extent to which travel substitution and stimulation is likely to occur and also selected impacts are estimated. A starting point for the prediction of these highly uncertain behavioural phenomena is a capsule review of the comparative features of teleconference methods (Table 7.1) and user satisfaction with these communication media in comparison with face-to-face in-person meetings (Table 7.2). While the strengths and weaknesses of the media displayed in Table 7.1 are a reflection of user requirements, the effectiveness assessment is based on results of laboratory studies and surveys of users of actual/demonstration services covered in Chapter 5.

Information presented in previous chapters showed that there is much consistency in numerous laboratory and field observations about the eligibility of in-person face-to-face meetings to be substituted with teleconference systems. From these studies, it can be inferred that 50% or even a higher share of business meetings could be regarded as eligible for substitution. See Figure 7.1 for results of research studies carried out in the U.K., Canada and the U.S.A. Similar results were obtained from investigations carried out in Europe, Australia and Japan.

Out of all business meetings, it is believed that 10% of such meetings could be carried out by the use of videoconferencing. For this segment of meetings, audio plus graphics would not be regarded as an eligible substitute. For the remaining 40% or more of meetings that could be transferred to audio plus visual support type of teleconference mode, video conferencing facilities would not be considered necessary. Also, considering the present high cost of video conferencing, it would be extravagant to consider it. However, in the future, cost reductions for videoconferencing might result in a higher share of substitutable meetings for the video conference mode.

Table 7.1
Strengths and Weaknesses of Teleconference Systems: Summary of
Major Features

<u>System</u>	<u>Strengths</u>	<u>Weaknesses</u>
Audio System (Telephone Conference)	• End-to-end multipoint capability • Widely available in Canada, worldwide network • Inexpensive and convenient	• Limited to voice communications • Lack of identity of speakers and lack of presence of participants • Limited effectiveness for complex tasks
Audio/Graphic Conference	• Graphics feature is valued by users • Available, economical and convenient • Speakers can be identified (e.g., lamps)	• Limited perception of the presence of participants except for speaker • Dedicated transmission channels required between locations • Intercompany conferences are not feasible due to incompatible systems
Videoconference	• More nearly stimulates face-to-face in-person meetings • All participants can be identified and seen • Graphics capability • Multi-point capability is feasible via satellite	• Standard TV technology used as a base • Video standards vary from country to country • High tariffs; High cost of equipment, transmission and studios • Availability of facilities is still limited

Table 7.2
Effectiveness of Communication Media

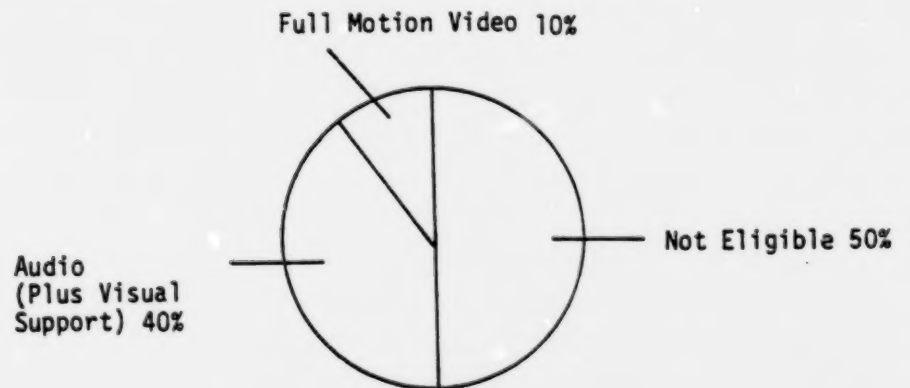
Type of Communication	Two-Way Audio	Two-Way Audio Plus Graphics	Two-Way Audio, One-Way Video	Two-Way Audio Plus Video	Face-to-Face
<u>Intra-Organization</u>					
(Mostly Acquaintances)					
• Operating discussions	High	High	High	Very High	Best
• Executive discussions	Low	Average	Average	High	Best
<u>Inter-Organization</u>					
(Mostly Strangers)					
• Operating discussions	Low	Average	High	High	Best
• Executive discussions	Very Low	Low	Low	Average	Best

Compiled from laboratory and field tests.

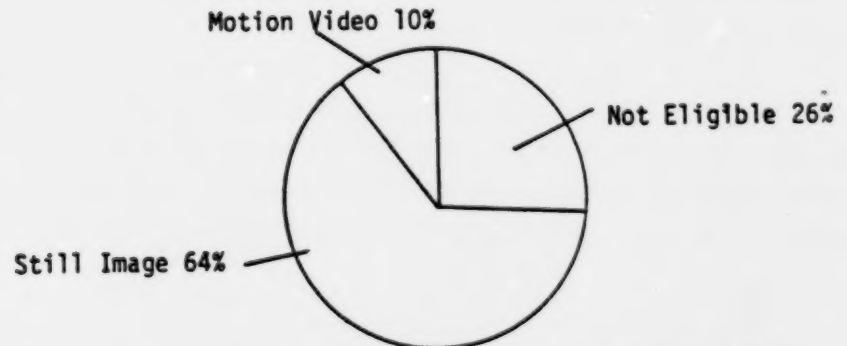
Source: Khan (Reference 12)



Source: British Research By CSP, London



Ontario TEMP (The Problem Solver)



Satellite Business Systems Studies (USA)

Source: Harkness & Burks

Figure 7.1: Behavioural Eligibility of Meetings

Bringing the time element into the picture, the penetration of electronic conferencing is projected to follow the pattern of consumer acceptance of new products. An attempt is shown in Figure 7.2 in terms of the projected acceptance of the various teleconference modes. Generally, similar patterns of market penetration in the U.S.A. have been suggested by previous studies, although a time delay of about 5 years in Canada is a logical difference between the two countries. In terms of interpretation, information presented in Figure 7.2 suggests, for example, that by year 2000, video conferencing would be in use by about 80% of its potential users.

Considering the high potential of the videoconference mode to be accepted as a substitute for in-person meetings, a careful re-examination of the behavioural factors has recently been undertaken in the U.K. As a result of a major study carried out by Communications Studies & Planning (CS & P) Ltd., for Defense Advanced Research Projects Agency (DARPA), the CS & P reversed itself on videoconferencing. Three main areas of new findings include: behavioural eligibility of videoconferencing for situations involving conflict resolution and negotiations, the concept of using video teleconferencing as an addition to quality audio or audiographic teleconferencing, and the examination of teleconferencing not as a simple replacement or emulation of face-to-face meetings (i.e., the substitution paradigm) but as a means to enhanced communications (i.e., the value added paradigm). Findings suggest that the videoconference mode appears to increase user satisfaction and is an important means to travel substitutions.

The transferability of the results of controlled laboratory experiments, and of attitude surveys of users and non-users to the real world in terms of actual level of substituting telecommunications, and the stimulation of travel owing to the availability and use of teleconferencing, involves major uncertainties.

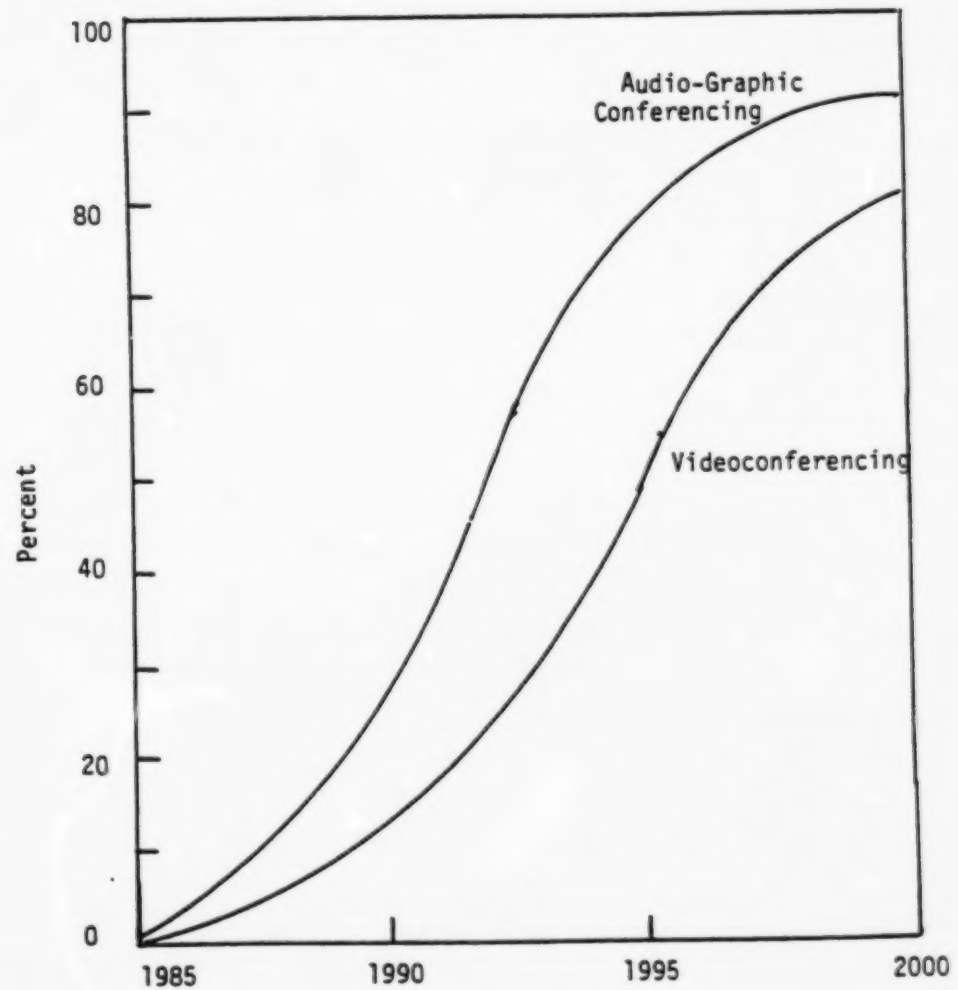


Figure 7.2: Penetration of Teleconferencing (Office Use Only)

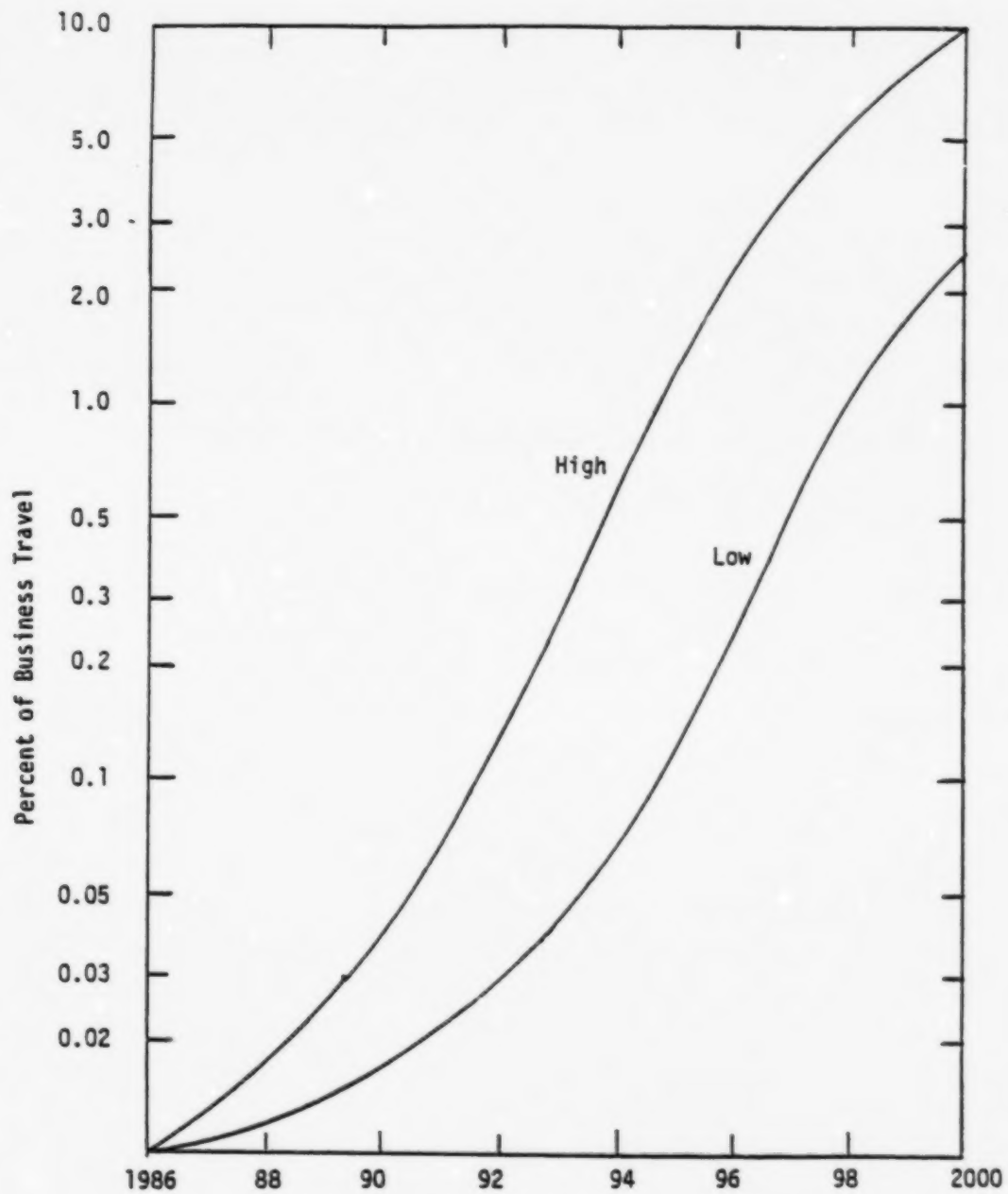


Figure 7.3: Percent of Business Travel Replaced by Teleconferencing

7.2 Travel Impacts

The reader is advised to review the projections presented here in the light of information and analyses presented and assumptions noted. Also, it should be pointed out here that long range projections of phenomena or events, even when there is considerable past experience with these, is by no means an accurate task. Projections of the effects of teleconferencing on travel demand is of course an area for which there is little prior experience. For this reason, deterministic and even probabilistic models of travel estimation were discarded.

Another notable point is that the percentages suggested later in this section are relative to a "base case" in which there is little influence of telecommunications on travel demand.

In the development of estimates of travel substitution and stimulation, the following observations were used as guides. These observations, in turn, are based on information contained in this report.

1. (a) For business travel, the upper limit of the level of substitution, stated in attitudinal terms, is 20 to 25% of base travel.
(b) The upper limit for the stimulation of business travel, derived from attitudinal survey results, is 2% of base travel.
(c) Non-business but institutional type of travel, such as travel related to medical and educational information exchange or other tasks, exhibits similar levels of substitution and stimulation.
2. The penetration of teleconferencing systems in the market is projected to follow the S shape curve shown in Figure 7.2. The market for video-conferencing, in relative terms, is likely to grow at a slower pace as compared to other modes of teleconferencing.
3. The increase in the differential of travel vs. teleconferencing costs is also likely to follow an S shape curve (Chapter 6). Such profiles of cost differentials are not identical for the various travel contexts. As a word of caution, it should be recognized that changes in transportation and teleconferencing costs are a function of a large number of factors (e.g., technical, market size and policy-related). Projection of costs

Table 7.3

Assessment of Selected Factors That Influence The
Substitution of Teleconferencing For Travel

Factor	Short Haul	Domestic	Long Haul International	North-South (Canada)
Cost Differential (Including Time)	Favourable	Highly Favourable	Highly Favourable	Highly Favourable
Convenience and Status	Highly Favourable	Favourable	Favourable	Highly Favourable
Service Availability	Favourable	Favourable	Favourable	Not Favourable

presented in Section 6.3 should be regarded with much caution.

4. The reliability of attitudinal survey results in terms of their applicability, in the "real world" case is at best believed to be 50%. A number of reasons for such an assessment are given below.
 - (a) While there is some evidence in a limited context (involving a number of organizations) that the use of teleconferencing leads to a reduction in travel, its extent is not at the level suggested by large scale attitude surveys of teleconference users.
 - (b) A number of research projects that offered conclusions on travel displacement assumed that in the absence of the teleconference system(s) under study, the participants would have travelled for an in-person meeting. Also, such studies have frequently assumed that the number of participants in a teleconference would have been the same as the size of the travelling party. This assumption is contradictory to other research that indicates that 50 to 60% of participants in teleconferences would not have been present if the in person meeting (involving travel) had taken place.
 - (c) The narrow "single-purpose" questions or even questionnaires about travel substitution or stimulation would induce somewhat less reliable responses.
5. It appears reasonable to suggest that, in the absence of other changes, improved communications will lead to more business activity involving distant parties which may in turn increase demand for all modes of communications, including travel.
6. It is highly unreasonable to dismiss teleconferencing as irrelevant should one wish to reduce travel. It is likely that in the future, organizations wishing to follow a policy of reducing business travel by their employees would consider the use of teleconferencing in order to minimize the risk of communication loss and thus are likely to consider trade-offs between travel, budget cuts and teleconferencing expenses.
7. As previously noted in this report, teleconferencing is not likely to influence travel by the automobile and bus modes. It is argued that only air and rail (in short haul corridors) can potentially be impacted. One of the attractions of teleconferencing for business meetings is that it saves

time as compared to travel. Considering that car and bus modes are selected as the travel mode for reasons other than savings of time, these modes cannot be considered as competitors to teleconferencing.

8. Ad hoc teleconferencing is likely to have differential effects on travel within the air transportation network. While travel substitution is likely to occur in trunk routes, feeder air links would experience stimulation of travel owing to the transportation of participants to the teleconference sites.
9. The estimates of substituted travel consider cost differentials as well as other factors (e.g., convenience) as noted in Table 6.1. Table 7.3 shows such balancing considerations. For reasons shown, in spite of a favourable cost-differential in long haul international routes vis-a-vis short haul corridors, the level of substitution on the international routes is assessed to be the same as (or could even be somewhat less than) short haul corridors.

On the basis of the foregoing, it is projected that teleconferencing may substitute for up to 11% of intercity business travel by the air mode. Intercity rail travel in short haul corridors would experience a similar level of substitution. As for stimulation of travel, a 1% level of stimulation is projected for these modes. The balance of substituted and stimulated trips leads to a 10% level of business travel replacement by teleconferencing. A lower estimate of 2.5% is suggested as well.

The profile of business travel replacement by teleconferencing is shown in Figure 7.3. The growth of replaced travel is likely to take an S shape owing to the profiles of cost differentials (Section 6.3) and market penetration (Figure 7.2).

The number of replaced air trips can be estimated from a knowledge of business travel by the air mode as well as the projected level of diversion. In 1980, 42% of air travel, according to Canadian transportation survey, was in the "business" category. Total air travel by Canada's national and regional carriers was 23.97 million passenger trips or 39.93 billion revenue passenger-kilometers.

Transport Canada's projections of (domestic) air transportation suggest an overall growth rate of 3.5% per year from 1980 to 1995. Assuming this average overall growth rate to hold for 1980-2000, total air travel will grow to 47.7 million persons or 79.46 billion revenue passenger-kilometers.

As compared to a base case of zero travel replacement, in the year 2000, 1.963 million business air trips would be replaced at the replacement rate of 10% of business travel. The lower estimate of 2.5% would of course amount to 0.49 million trips.

In the case of rail travel, in 1980, about 20% of rail travel was estimated by the CTS to be business travel. Passenger trains in 1980 carried about 7.4 million intercity passengers or about 2.9 billion passenger-kilometers (Statistics Canada). Transport Canada projects an overall annual growth rate for rail travel to be 4.4% in the 1980-1995 period. Assuming that this rate applies to the 1980-2000 period, total rail travel will grow to 17.54 million intercity passengers or about 6.87 billion passenger kilometers. As compared to a base case of zero travel replacement, in the year 2000, 0.35 million passenger trips would be replaced by teleconferencing.

7.3 Effects on Document Traffic

Major corporations have already invested large sums of money on data transmission equipment. Data communication services, as noted in Chapter 3, are already available in Canada as well as at locations of interest to Canadian corporations. Significant economies are being achieved in data communications (including electronic messaging) owing to the shared use of satellite earth station equipment with voice and other traffic.

While mail and message-size items that have traditionally been transported, are totally substitutable, less than half of parcel size documents, now transported by the courier industry, could be sent via telecommunications. The intercity couriers have already lost part of their traffic to telecommunications (i.e., in the form of electronic transmission of facsimiles).

At least one major courier company, namely the Federal Express Company, has been considering the use of a satellite based transmission system to send documents electronically in the line haul portion of its network. The task of pick up and delivery, however, still remains in the hands of the courier. In the future, office-to-office communications would enable businesses to receive mail, messages and documents electronically. This will eliminate the role of the local courier for such tasks as transportation of messages between offices and points of electronic transmission (or mail terminal).

The direction of the impact of telecommunications on documents traffic is quite clear. However, the extent of such an impact in specific traffic contexts remains as a research task.

7.4 Energy, Infrastructure and Other Impacts

Transportation accounts for about 50% of petroleum energy consumed in Canada. Energy savings potentially achievable from the replacement of travel have been viewed with much interest by the governments. As for air transportation fuel, it should be noted that in 1980, 4.6 billion litres of Turbo fuel and 0.2 billion litres of aviation gasoline were consumed by this sector. Teleconferencing could save up to 201.6 million litres per year at the 1980 level of consumption, which is about 4.16% of air transportation fuel requirements.

As for rail transportation, up to about 4.4 million litres of diesel fuel could be conserved at the 1980 consumption level which is about 1.6% of passenger rail energy. This small magnitude of savings in the rail mode reflects the fact that passenger rail, owing to its relatively small transportation output, accounts for only about 0.25% of overall Canadian energy consumption. In the estimation of energy savings for intercity passenger rail, it is assumed that the load factor is maintained at the base level by adjusting seat supply.

Infrastructure impacts are a logical outcome of travel replacement. The estimates of replaced trips in essence imply that at congested locations within the air transportation network, there will be less pressure to expand capacity. The same cannot be said about passenger rail since there does not appear to be a problem of infrastructure capacity (e.g., at stations).

A serious impact, at least for the air and rail carriers, is the loss of revenue from business travel replacement. Airlines have been increasingly aware of the potential loss of a segment of their business travel market which is the core of their livelihood. The business traveller today is the more profitable segment of the airline business.

While this research concludes that there is the likelihood of travel replacement (i.e., the balance of substitution and stimulation effects), there are at least two points which should partly alleviate cause for concern. Firstly, the replacement process is likely to be a phased one -- taking up to 15 years to reach its potential. Secondly, the upper limit of the replaced travel is projected to be about 10%, while most airline spokespersons feared that it could be as high as 20% or more.

Chapter 8

CONCLUSIONS AND RECOMMENDATIONS

Summary of Results and Conclusions

This study investigated the effects of telecommunications on intercity transportation demand in terms of the substitution of communication modes for in-person meetings and the stimulation of travel owing to the use of communication modes. Additionally, impacts such as energy savings, relating to demand substitution and stimulation were estimated. Major findings and conclusions arising from the study are presented below.

- (1) Communication needs have been accorded a deserving research attention in a number of countries. Numerous studies in Canada and elsewhere have produced remarkably similar results in terms of the percentage of meetings that could be carried out through teleconferencing (and the extent of potential substitution of travel). On the basis of these findings, about 50% of business meetings (with 40% to 60% range), involving information exchange/ transmission and similar tasks are potentially substitutable. Attitude type of surveys also suggest that 20% to 25% of business trips are substitutable by teleconferencing. Recent research shows that tasks involving negotiations (with risk) could even be regarded as substitutable. This implies that 60% or even a higher percentage of business meetings can potentially be carried out by teleconferencing.
- (2) Laboratory and field studies indicate that in addition to acceptability by consumers of teleconferencing as a substitute for travel, there are communication tasks which result directly from teleconferencing and require travel (e.g. follow-up meetings for the implementation of decisions). The extent of such travel stimulation was attitudinally stated to be about 2% as compared to a 20% to 25% level of substitution.

- (3) The quality, availability and cost characteristics of teleconferencing services are improving rapidly. While audio teleconference systems have been available for about a decade, the introduction of commercial video-conference service is a relatively recent occurrence. In late 1983, Telecom Canada introduced its satellite-based Conference 600 service. While initially available in Toronto and Calgary, this service is planned to be expanded to 19 Canadian cities. Also, in 1983, Teleglobe Canada started its Confratel service between Toronto and London with a Toronto-Paris link to be added in the near future. Also, services between Toronto, Montreal, Vancouver and major European and possibly Pacific Rim cities are likely to be introduced in the future.

The use of teleconferencing is also growing in medical services, education and government services. While the Ontario Government has been a leader in the use and promotion of teleconferencing, the Government of Canada through its Telecommunications Agency is planning to enhance its teleconference facilities. There are also a number of private facilities for teleconferencing that have been designed to meet customer needs.

- (4) Teleconferencing service demonstrations and commercial services are also on the rise in the U.S.A., Europe and Japan. International teleconferencing is now possible owing to specially designed equipment that overcomes the compatibility problems of different video standards.
- (5) Pro-competitive telecommunications policies in the U.S.A., and U.K. have stimulated cost and service type of effects which are favourable to teleconferencing. In Canada, similar developments have occurred on the telecommunications equipment supply side of the industry.
- (6) The technology of teleconferencing has developed rapidly. Most notable among these developments are echo free audio systems, high speed facsimiles, reduction of transmission capacity requirements for videoconferencing, less costly earth satellite stations, and partial coverage of satellite foot print (e.g., 1/2 Canada). As a result of these and other developments, the cost of teleconferencing has dropped significantly while the quality and availability have improved.

- (7) Most existing teleconferencing systems are of the audio and audio-plus graphics type. Projections for future developments also suggest such a general trend but the share of freeze/frame or slow scan teleconference systems will increase. Videoconferencing, although most effective in simulating person-to-person meetings, is likely to grow at a slower rate owing to relatively higher cost of equipment and transmission charges.
- (8) Recent surveys in Canada and the U.S.A. indicate that a substantially high percentage of businesses are already using teleconferencing on a routine basis. In Ontario, according to survey results, almost three-quarters of businesses are using teleconferencing for business meetings, training programs and special events.
- (9) Interest in teleconferencing is positively correlated with the size of a firm's travel budget. Also, the recent recession has induced travel budget cuts and an interest in teleconferencing. However, the relationship (i.e. trade-offs) between travel budget and teleconferencing/telecommunications costs is not a formal one (at this time) within an organization's financial structure. There are indications that in the future, organizations which wish to reduce their travel activity would look toward teleconference systems as a viable option.
- (10) The cost of audio conferencing at present is quite low as compared to travel. However, due to the absence of graphics and other features of a face-to-face meeting, its impact on travel is not significant. Freeze frame is a reasonably inexpensive communication means but its coverage is rather limited at present (to mostly intra-organization linkages) and there is a problem of equipment incompatibility. Videoconferencing systems are relatively recent and offer the potential to serve as substitutes for domestic, transborder and international travel. However, their costs are still too high to be readily accepted by potential users.

- (11) Costs and service characteristics of videoconferencing were analyzed in this research and differences of service and cost were projected for future years. Results show that at present videoconferencing is in general costlier than travel for the short haul (Toronto-Montreal) link as well as the long haul (Toronto-Calgary, Toronto-London, England) links. Owing to projected cost decreases for teleconferencing (i.e. two-thirds by 1990, one-half by 1995), and in spite of a temporary 10% reduction of air fares by 1990, teleconferencing will become increasingly attractive in the future. Cost savings in relative terms are expected to be high for long haul routes and for meetings involving four or more travellers. While the cost savings (resulting from the replaced travel) are more favourable for long haul domestic and international links, the inconvenience of the same-day return journeys in short haul corridors (involving same destination for frequent travellers) renders such routes equally attractive for travel substitution. As for North-South travel within Canada, the high cost of air travel and the inconvenience of layovers make such links also attractive for the substitution of travel with teleconferencing. However, owing to low density communications, commercial videoconferencing network is likely to be modest in size. Clearly, there is an increased role for institutional/governmental installations for North-South communications.
- (12) Examination of the results of analyses as well as an assessment of the reliability of attitude surveys (in terms of the transfer of their results to the real world) led to the development of a projected profile of air and short haul rail business trips. It is projected that starting from a negligible level of replaced travel in 1984/85, in the year 2000, 10% of business trips by air and rail will be replaced by teleconference. The 10% replacement level is measured against the profile of travel growth which is not affected by teleconferencing, and reflects 11% substituted travel as well as 1% stimulated travel. The growth in replaced travel, like the penetration of teleconference systems (in the office environment), is expected to follow an S-shape curve. On the basis of projected air and

rail travel in Canada, by the year 2000, up to 1.96 million air trips and 0.35 million rail trips are likely to be replaced by the teleconferencing mode. Energy savings that correspond to replace travel are noted in Chapter 7 of this report.

- (13) Telecommunications are also expected to impact documents traffic. Developments in office automation, digital and local area networks are likely to affect the transportation of mail, messages and documents traffic. The intercity couriers have already lost a part of their documents traffic to facsimile transmission systems. According to the courier industry, slightly less than one half of their documents traffic could be eligible for transmission by telecommunications media.

Recommendations

Information and analyses presented in this study and conclusions reported above (in this chapter) suggest the following recommendations:

- (1) While a 10% level of business travel diversion to teleconference systems in the distant future (i.e. sixteen years from now) is not necessarily a cause for concern for the air and passenger rail carrier industries, it is nevertheless significant enough to warrant frequent monitoring and analyses. Likewise the probability of significant diversion of documents traffic to telecommunications gives a strong reason for on-going investigations of this topic.
- (2) As a part of future investigations on the topic of this research, every attempt should be made to improve the travel and communications behaviour information base through the addition of specially structured questions on this subject.
- (3) Another area of critical information need is that of travel budgets and telecommunication/teleconference expenses in relation to revenues and

operating expenses of businesses. Analytical studies are currently hindered as a result of lack of information.

- (4) The theme of cost and service differential and the concept of threshold level introduced in this research requires further quantification. Following a number of years of Teleconference 600 (offered by Telecom Canada) and Confratel (of Teleglobe Canada) experience, a survey of users could be initiated in order to acquire data for the quantification of the variables involved.
- (5) As for the use of teleconferencing as an enhanced communication means as well as a mechanism for controlling travel budgets, Ottawa could be linked through a videoconference network with all provincial and territorial government capitals. However, the need to establish a videoconferencing system (compressed video or slow scan system) for North-South communications in Canada is much more pronounced.
- (6) Through the efforts of the Treasury Board and the Government Telecommunications Agency, federal government departments and agencies should be given a better appreciation of the potential of teleconference systems in satisfying the communication needs of their members.

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APPENDIX A

GLOSSARY

- Ad hoc: Facilities are temporarily connected for a specific event; Ad hoc conference means occasional use.
- Add-on: A communication system that permits users to add a third party.
- Analog (Analogue): Information (signal) is in the form of a continuous waveform.
- Audio teleconferencing: Two-way interactive electronic voice-only communication between three or more persons in two or more locations.
- Audiographics: Transmission of graphics and text information over a narrow-band telecommunications channel such as a telephone line.
- Bandwidth: The range of frequencies/maximum frequency (measured in Hertz or cycles per second) that can be carried by a transmission medium.
- Baud: Information flow rate, expressed as bits/second (bps); the rate is the maximum number of bits/second that can be transferred between two devices.
- Bit: It represents a "binary digit" (0 or 1 -- On or Off which is the basis of information handling in computers).
- Bridge: An equipment that is used to interconnect three or more telecommunications channels such as telephone lines.
- Broadband (wideband): A transmission medium that can carry high frequency signals (e.g. full motion television frequencies of 3 to 6 million hertz (MHz)).
- CATV -- CableTelevision: A transmission system that carries broadcast (i.e., one-way) television signals and other (non-programming) services by means of a coaxial cable. However, most cable systems permit two-way communication in addition to broadcast television.
- Coaxial Cable: A metal cable which consists of a conductor surrounded by another conductor in the form of a tube; such a cable can carry broadband signals.

- Codec:** It is a coder-decoder device, designed to convert analog signals (e.g., voice or video) into digital form for transmission over a digital transmission medium and to reconvert the signals to the original analog form. Codecs also can be designed to carry out other signal processing functions.
- Communications Satellite:** When placed in orbit above the earth's surface, it serves as "relay system" for voice, video and data signals. A communication satellite of course requires earth stations for receiving and transmission of signals.
- Compressed Video:** In such a system, owing to the processing of video images in the form of removing redundant information, bandwidth requirement for the transmission of video signals is reduced.
- Compressed Video Codec:** It is a device for signal coding and processing which compresses the amount of information to be transmitted. Such a device may perform other functions as well.
- Comp3ter Conferencing/Keyboard Conferencing:** It implies interactive communications with a group through computers; it is based on the use of shared computer files, remote terminal equipment and telecommunications channels.
- Dedicated Lines:** Telecommunications circuits that are based for specific application (e.g. based telephone lines used for a teleconference network).
- Digital:** As contrast to continuous or analog signals, digital form of information is represented by signals at discrete steps or intervals.
- Direct Broad Satellite (DBS):** A powerful new generation satellite that requires inexpensive earth stations for reception of signals.
- Downlink:** It is an earth station that receives satellite signals.
- Earth Station (Earth Terminal/Ground Terminal):** A collection of ground equipment (including a dish and associated electronics) used to transmit and/or receive satellite communications signals.

- Echo Free Audio Equipment:** Modern equipment which eliminate the effects of the reflections of signal energy (that cause it to return to the transmitter or to the receiver). Echo cancellers used in satellite communications eliminate echo in audio transmission.
- Electronic Blackboard:** This device is designed to produce free-hand information that is transmitted over a telecommunication channel such as a telephone line.
- Electronic Mail:** A system for sending and receiving messages electronically -- includes computer mail and facsimile.
- Encryption:** It is the activity of special coding, or scrambling, of a signal for confidential communications.
- Facsimile:** This device electronically transmits and reproduces page copies and documents.
- Fibre Optics:** This medium is based on a laser transmission that uses a fibre which carries light.
- Freeze-Frame Video:** It transmits and/or receives still video pictures over a narrowband or wideband telecommunications channel.
- Four-Wire Transmission Circuit:** It has two pairs of conductors (four wires), one pair for out-going and one pair for receiving. It permits persons at two locations to talk and be heard at the same time.
- Hertz (Hz):** A unit of frequency -- one hertz is equal to one cycle per second.
- Hybrid System:** It combines two or more communications technologies (e.g. full motion video plus graphics capability).
- Interactive System:** A telecommunications channel that permits the two-way exchange of information.
- Integrated Services Digital Network (ISDN):** A digital telecommunications channel that permits the integrated transmission of voice, video and data.
- KiloHertz (kHz):** One thousand Hertz (cycles per second).
- Meet-Me Bridge:** A telephone bridge that can be accessed directly by calling a certain access number.

Mega Hertz (MHz): One million Hertz (cycles per second).

Microwave: High-frequency radio wave used for the data, audio and video signal transmission. It requires that the transmitter and receiver have a clear line of sight.

Multiplexing: Transmission of signals from different sources over a common channel simultaneously.

Narrowband: A transmission channel with low capacity for the carriage of signals -- e.g., telephone line.

PBX: Private Branch Exchange -- a private telephone exchange.

Slow-Scan Video: It transmits and receives still video pictures (see Freeze-frame video).

Telco: Telephone Company -- implies a facility located at the company plant.

Telecommunications: Any transmission, emission or reception of signs, signals, waiting, images, sound or intelligence of any nature by wire, radio, visual or other electromagnetic system.

Teleconferencing: Two-way interactive communications between three or more persons in two or more locations by a telecommunications medium.

Transponder: A mechanism on a communications satellite that receives the signal from earth, amplifies it and sends it back to earth for reception.

Teletex: Transmission of information from a central data base to a receiving television set.

Uplink: It is an earth station that transmits a signal to communications satellite.

Video Compression: It is the technique of reducing bandwidth required for the transmission of video images.

Video Teleconferencing (Videoconferencing): Two-way electronic voice and video communication between two or more locations; includes full-motion video, compressed video and at times freeze frame video.

Videotex: It is similar to teletex but permits user interaction with the data base for the selection of information for viewing.

APPENDIX B

HIGHLIGHTS OF FINDINGS OF

ATTITUDE SURVEYS



Highlights of Findings of Attitude Surveys

Survey

Telecom Canada
Business Teleconferencing
Study (1983)

Major Conclusions

- Users: (mostly) managers/executives; frequent users were from Finance, Business services, and Professional and Trade Associations; mostly part of HQ operations
- Few mentions of problems with Conference 100: scheduling, cost, difficult to use, sound and transmission quality.
- TC calls were predominantly short intra-organizational (32 min., 3-6 persons).
- TC is used commonly for decision-making, information sharing, administration and sales meetings; most frequently where the alternative is a face-to-face meeting.
- High satisfaction (for saving travel time, money, and being prompt) but 39% recognize TC as accomplishing less than face-to-face -- limits the time and scope of discussion, no visual feedbacks).
- Strong expression of desire for video backup.

TEMP, Ontario Survey, (1983)

- Major advantages of TC: saves time (61%), saves money (37%), improves general efficiency (18%), allows more staff to attend the same meeting (18%).
- Major disadvantages of TC (cited less often than advantages): loss of face-to-face contact (17%), the high cost of TC (13%), equipment problems (7%), scheduling difficulties (5%).
- 70% of users strongly believe that senior executive support is needed for TC adoption.
- 45% strongly believe that reducing travel time or cost is a major reason for adopting TC.
- About two-thirds believe that TC has no effect on their business travel; about one-quarter say it has decreased their business travel (avg. decrease is 20% of trips).
- 2% see an increase in business travel due to TC.
- Attitudes of users are generally favourable.
- About 60% of users estimate that 20-25% of future trips can be replaced by TC.

Survey

Government Telecommunications Agency Survey (1983)

Major Conclusions

- The effectiveness of TC as a substitute for face-to-face meetings depends to a large degree on familiarity with use of system and sophistication of the system.
- TC with audio and full video capability is most effective.
- For specific purposes, audio plus graphics should suffice until technology is further developed and full video becomes more available and less expensive.
- User hands-on training is essential.
- TC should be convenient to arrange.

University of Wisconsin (Extension) Survey of North American Teleconferencing Users (1983)

- Much variability in satisfaction with the different system types.
- Full motion video tended to be slightly more satisfying than other systems.
- Nearly 85% of sample regarded TC as successful or very successful. The remaining 15% was divided between mixed success or unsuccessful.
- Reasons for TC success: user acceptance (25% of organizations, cost-effectiveness, increasing use patterns, system's ability to meet user needs, saves travel time).
- Effects of TC on the organization: more people involved in decision-making, decrease in travel time, faster decision making, shorter meetings, relationships between sites improved, decreased travel costs, savings of substantial amounts of money, better planned meetings, better decisions.

Picturephone Meeting System (PMS) User Survey (AT & T) (1983)

- Video conferencing is most commonly used for information and opinion exchange; also for consensus-building activities involving group decision-making.
- Used for several more highly "personally" involving tasks.
- Used for organizational and inter-organizational meetings by a wide variety of (profit and non-profit) organizations.
- Frequent usage by large organizations and by firms within telecommunications, insurance, and health services industries.
- Used by users from a host of different functional areas, organizational levels, and unit sizes.

Survey

Picturephone Meeting System
(PMS) User Survey (AT & T)
(1983) (continued)

Major Conclusions

- More frequent usage by top management and marketing personnel.
- Videoconferencing tends to be used more interactively (i.e., involving discussions).
- Conferences included many individuals who would not otherwise have attended the meetings.

Pilot (Trial) Survey of
Organizations -- Holbrook
for DOC

- Quality of TC regarded as good.
- Medium to high rating of TC as a way to remain in one's office.
- Availability of staff backup when in one's office (high rating).
- Timesaving (through TC)(very high rating).
- Through travel, ability to have direct contact and informal sessions (assigned high priority).
- Overall, positive attitude toward TC.

Bell Canada's Conference
TV User Evaluation (1979/80)

- Users stress the benefits of economy and efficiency as prime motivations for using the system.
- Overall assessment: positive.
- Problems: poor audio and video quality, malfunctioning cameras and background noise.
- Perceived barriers to increased use: unavailability in locations where they are required, the novelty of conference TV as a communications medium, and user preferences for both face-to-face meetings and audio conferencing.
- The price of Conference TV (under demonstration tariffs) was not perceived to be a major barrier to increased usage.

Bell Canada's Conference TV
Demonstrations (1979/80)

- Favourable reaction to audio-visual conferencing.
- The need to expand service to Eastern and Western Canada.
- A majority (63 out of 82) of respondents did not intend to use the service for the following principal reasons: high price, the need for more than a two-point conference TV facility, little use within their organizations, perceived difficulty in persuading business associates to use the service, overall preference for face-to-face meeting followed by conference calling and long distance communication, unavailability of service in locations where it is required (e.g., Eastern and Western Canada) limits its usefulness.

Survey

An Evaluation of the Audio Teleconferencing Demonstration Project at the MTC (Ontario) (1978-1980)

Major Conclusions

- Main advantages of TC: reduced travel, shorter meetings, more staff attending, reaching a decision or consensus more rapidly.
- Main disadvantages of TC: Loss of face-to-face contact and non-verbal communication, unsuitability for all meeting types, more meetings required to complete business, and more stressful or tiresome meetings.
- TC has made little impact on their operations or organizational efficiency.
- TC has improved information exchange.
- TC has enhanced management efficiency.
- Over 96% of users are satisfied with TC as a means of communications.
- Approximately 90% of users are satisfied with equipment and transmission quality.

Study of Teleconferencing for Various Meeting Activities Comparison of Four Systems (1977)

- Teleconferencing used primarily for routine meetings involving information exchange.
- Least satisfaction for situations requiring personal contact (for negotiating, bargaining and brain storming).
- Video system is rated higher than others for "person-to-person oriented" activities.
- Audio teleconferencing was found to be most successful for giving or receiving information -- the success attributed to the greater flexibility, usefulness, and less expense of the system relative to others.

Bell Canada's Survey of Travellers (1973/75)

- The results were disappointing -- relationships were found to be very weak, although in most cases relationships between the variables and the decision to substitute were found to be logical.
- Results could not be used to determine who would substitute telecommunications for travel or why?
- A majority of the travellers indicated that even if they had access to teleconferencing devices, they still would have preferred to travel. Also, their current frequency of business travel would not decrease in general.

Survey

Bell Canada's Survey of
Travellers (1973/75)
(Continued)

Major Conclusions

- As travel frequency increases, a desire to cut trips by the majority of a category is not expressed until travel reaches an average of every other week of the year.
 - Travellers desiring to limit their travel were not necessarily prone to substitution.
 - Respondents were less prone to select video devices as teleconferencing system components required to substitute for their travel.
 - Many travellers (but not a majority) visited friends or relatives while on their business trips.
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APPENDIX C
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